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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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VOL. X. NEW YORK, NOV. 5, 1887. No. 19.

WE regret to learn that the proceedings of the last three meetings of the National Electric Light Association have not been published owing to a lack of funds for that purpose. While the officers of the association may justly hesitate at levying an assessment for the intended purposes of raising a fund to be used to bring before Congress the matter of Patent Office legislation, we think they ought not to scruple at this method of raising money for a purpose which will not only materially benefit each member, but will be a lasting proof of the strength and usefulness of the society. The volumes of proceedings already published are most creditable publications, and are records which may well be kept for future reference.

As the distribution of electricity for various purposes constantly increases, the question of its measurement assumes a more important position day by day, and although great ingenuity has already been displayed in this direction in the past, the work still going on shows that inventors are not yet satisfied with the results obtained. Only recently, we published the description of a most ingenious apparatus of Prof. Forbes intended for this purpose, in which the heat generated in a wire produced air currents, which are employed to drive a registering train. In this issue we describe an entirely different plan in which the electric motor is utilized for the same purpose. The ease with which the electric motor lends itself to regulation makes the operation of such a device seem simple, the only uncertain factor appearing to be the amount of friction encountered in the motor.

THE analogies which exist between the dynamo and the steam engine form a very interesting theme for study; and though not all of those pointed out by Mr. Watts in another column are to be taken as strictly true, they nevertheless form a valuable means of fixing ideas by means of similarity with an object more familiar to a large number of those who may be placed in charge of dynamo machinery without previous preparation. Both the electric current and the action of steam are manifestations of force, and hence it is not strange that similarities should exist in their application.

OUR English contemporaries still continue to discuss the proposed plan of establishing a society similar to our National Electric Light Association, and a host of their correspondents express in unmistakable terms their willingness to support an institution of that character. A few, however, who seem not to fully understand the nature of the intended association express fears lest the work of the new society may interfere with the functions of the societies already in existence, such as the Society of Telegraph Engineers and Electricians, the British Association, and other scientific societies. But it is evident that the objects of the new society are entirely different from the latter and, instead of interfering, would rather be an aid to them in advancing their scope of usefulness. An English electric light organization molded on the lines of our own would find much work ready for it both in the matter of securing much needed legislation and for the mutual understanding between electric lighting companies.

WE print in another column the circular issued to the members of the National Electric Light Association, and which is well worthy the attention of all engaged in electrical work. We have so often pointed out the condition of the Patent Office that no repetition need here be made to demonstrate that a commission to inquire into and suggest a remedy for the existing state of affairs is absolutely necessary. Considering what American inventors have done for their country, they are certainly entitled to ample consideration at the hands of the Government, and it is only concerted action, such as that designed to be undertaken by the National Electric Light Association, which will bring about the desired results. The amount asked for is certainly reasonable enough, and if the committee succeed in their attempt they will have merited the thanks not only of all electrical inventors but those engaged in every other branch as well. Hence, it would appear that the contributions need by no means be restricted to the electrical fraternity, and the committee might with propriety appeal to other than electrical interests to raise the sum desired. We have no fear, however, that the money will not be raised among the latter if determined efforts are made to this end, and we hope to see the next Congress appoint a commission which will relieve the Patent Office of the burden under which it now staggers, and the inventor of the inconvenience to which he is put under the present system.

THE recent consolidation of the Baltimore & Ohio and Western Union companies has not yet ceased to be a topic of general interest, and the results which may be expected are likely to maintain this interest for some time. That the "deal" is legally executed is evident from the fact that three-fifths of the Western Union stockholders have given written consent thereto. But a curious phase of the question is brought out in the action of the companies in the matter of the forfeiture of the bond given by the Baltimore & Ohio Company to the city of Philadelphia as a pledge of its independence. From the general ratification of the Western Union stockholders it is evident that the entire systems of both companies have been merged; yet under examination the Western Union representative in Philadelphia testifies that he has no knowledge of any consolidation in the State of Pennsylvania, and he refused to answer to a like question with regard to other States. It would be interesting to know under what plea such a construction of the consolidation could be supported. It is clear, however, that this action, together with the general increase in rates affected by the consolidation, will provoke serious efforts to secure legislation to regulate Inter-State telegraphing. Indeed, it is understood that several bills have already been drafted with that end in view, and will be introduced at the next Congress. At the same time, the old government telegraph schemes have had new life put into them, and altogether the telegraph is likely to be the subject of considerable agitation and legislation in the near future.

THE communications which have reached us in regard to a telegraph repeater recently described in our columns show that the telegraph fraternity, though now comparatively seldom heard from, still maintain an active interest in the progress of their department. Considering the work that has been done in the past, it would, indeed, seem difficult to devise new arrangements which would be of sufficient advantage to cause the abandonment of those at present in use. But, notwithstanding this, man's mind is so constituted that the search for the new forms to-day one of his strongest traits, and it is this impulse to which we owe our many improvements, especially in the department of applied electricity. Though, as Mr. Wm. Maver, Jr., points out, "the repeaters at present, and for a very long time past in use, are as simple and inexpensive as they well can be, consistent with efficiency," this is by no means a reason for abandoning the search for the new, for frequently the simple apparatus of to-day appears complicated when compared with that of to-morrow. As if in corroboration of this, the interesting communication of Professor Houston, printed in another column, shows that even in what is now looked upon as the "early days" of electrical science, the opinion was prevalent that the boundary of progress in this direction had been reached. But the words of Professor Cavallo are as true to-day as when they were written nearly one hundred years ago: "But, however, the *ne plus ultra* is, in all probability, as yet at a great distance, and the young electrician has a vast field before him highly deserving his attention, and promising future discoveries, perhaps equally or more important than those already made."

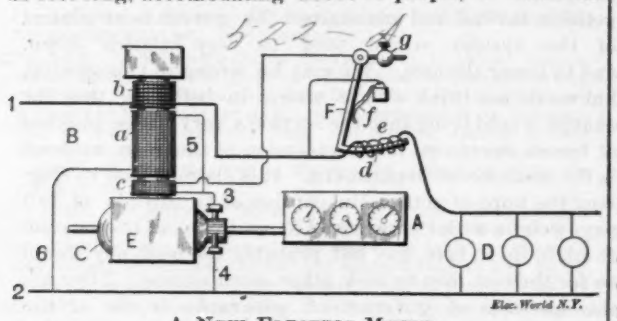
IN a late interview, Mr. Lambe, of the English Government Telegraph Service, stated that he had received many requests from Congressmen for information as to the working of the system here, and he remarked: "The bills now under consideration are very crude; especially are they lame in the matter of salaries for the officers. No country can afford to pay its officials mean wages, and particularly does this apply in the inauguration of an experiment or any new service. As district superintendents, operators, etc., you want men with ripe experience and good judgment, and these cannot be obtained without good salaries." This is extremely forcible and pertinent, and brings out an aspect of the case that is worthy of note by operators. Undoubtedly, a government service will give them greater security as to tenure of office, but will it bring them higher pay, or pay even as good as now prevails? The present rate of salary in the telegraph companies is not at all high, but the enormous competition invited and maintained by government control of the system would tend to keep salaries down, and to lower the rate. We may be wrong in this opinion, but we do not think we are wrong in believing that the change would bring into the service a very large number of female operators, to the exclusion of the men, at least in the commercial department. It is claimed that in England the hope of getting the pension of two-thirds of full pay weighs with the men and keeps them in the service. It might do so here, too, but probably the tendency would be for the best men to seek other occupations. After all, this question of government telegraphs is one of the largest now before the country and the electrical profession, and it is well to look at it from every possible standpoint.

WHILE street railway men are, as the recent convention at Philadelphia showed, ready to appreciate the advantages of electric locomotion, their willingness to investigate is met by an equal desire on the part of electricians to explain the reasons why they consider electricity the best power for the purpose and to have the various systems carefully and exhaustively examined. In this respect, the introduction of electric motors has been attended by circumstances from which it is impossible to draw other than the brightest augury. There has been no wild, frantic booming, such as attended the first use of steam on railroads, and of which perhaps England with her Hudson afforded the most striking and awful example. Nor has there been such a network of falsity and mystification around the electric motor as has enveloped the extraordinary proceedings and claims of Keely in this country. In only one respect has the department of electric railway work been open to criticism, and that is in respect to the use of the storage battery. But admitting, as one may, that in days gone by assertions were made that facts were lacking to substantiate, we doubt whether any branch of electrical application is being now more closely studied, and with more encouraging results, than the use of storage batteries on street cars. We know, of our own knowledge, that the batteries in use of more than one make are coming up to the guarantees in the most encouraging manner, and that the tests repeated over nearly every yard run serve only to strengthen the convictions of those who have pinned their faith and reputation to the storage battery. This may seem strong language, but it is true, in spite of the evident crudity of much of the apparatus employed and the want of standard rules of construction and management. As we have said before, the introduction of storage cars will not be rapid during the next year or two, because the range and the possibility of improvement are so great, but we certainly expect to see a number of the largest roads in the country using them within five years. We also expect to see a notable use of the conduit system, and an almost universal adoption in smaller cities and towns of the overhead system. In fact just at present the overhead system is that undergoing the most rapid introduction, and with a few changes for the better, chiefly in the direction of making the conductor suspension somewhat more æsthetic, it will be found to be the ideal method for hundreds of places where roads have hitherto been objectionable and where the horse or the steam locomotive would be rejected as a nuisance.

The Largest Electric Street Car in the World.

The recent visit of the members of the Street Railway Association to the works of the Electric Car Company of America, Mr. Wm. Wharton, Jr., president, Philadelphia, was one of the most interesting features of this year's convention. Car "number one," with Sprague motor, which we described some few months ago, was again called into requisition each evening in making trips on the Chestnut and Walnut street lines, the vehicle being usually crowded to its fullest capacity. Car "number two" is worked by the overhead system of conductors in the big yard at Twenty-third street and Washington avenue. Car "number three" was scarcely finished at the time when about 150 members of the convention visited the premises of the Electric Car Company of America, though Mr. Wharton's men had been working day and night on it. There was a delay of a week or so in getting the electric motors passed by the Custom House. These motors are of the Reckenzaun type, built by Messrs. Stephens, Smith & Co., of London, engineers, who have won some fame in constructing the launch "Volta" and quite a number of electric boats, as well as numerous electric motors for various purposes.

On this new car there are two motors, supported by two small trucks, similar to those on Reckenzaun's street cars in Europe. Each motor weighs about 500 lbs., and the pair, when working to their fullest capacity, are capable of giving 30 horse-power collectively. Such power will scarcely ever be needed, but it can be called into requisition should circumstances demand it. The car has been tested on the experimental line, and it was ascertained that the current, when mounting the grade of 5½ per cent. (264 feet to the mile), was only 80 ampères, on the level 25, and this current was supplied by 74 storage batteries; but there are actually 120 cells on board, stowed away under the seat on long boards, which run on rollers to facilitate the speedy removal and replacement of the whole battery. The seats are of the usual height and width, but they are 22 feet long, accomodating about 34 people, so that with



A NEW ELECTRIC METER.

the available standing room and platforms a hundred passengers can be crowded into the car. It is said that this is the handsomest and largest electric street car in the world. It is one of the most carefully designed in every detail.

The frames of the four-wheeled trucks are made of wrought iron; they have a very light appearance, yet they are of ample strength to support the maximum load with safety. The wheels are only 26 inches in diameter, which, when revolving at 103 revolutions per minute gives a speed of 8 miles an hour when the motors run at 824 revolutions, the armature speed being reduced 8 to 1 by means of Reckenzaun's worm gearing, which was described at a recent meeting of the American Institute of Electrical Engineers.

The speed of the car is regulated by a switch which causes the motors to work in series, singly or in parallel circuit, so that all the cells are always used when the car is in motion, whereby they are discharged uniformly, a result which will be appreciated by those who have some experience with storage batteries. The cells in this case are of the same shape and size as those on the car "number one," which were manufactured by the Electrical Accumulator Company, of New York. Large as this car is, it goes round the sharpest curves with remarkable ease, and altogether works well, the motion of the whole apparatus being absolutely silent.

The use of eight wheels removes the objections raised by street railway men with regard to the additional weight of storage batteries, so that by distributing the load over 8 points on the rails there is no need of providing stronger roads. Pivoted trucks with short wheel bases facilitate the movement round curves very much; there is no jerking as in ordinary four-wheeled cars, and, therefore, the flanges of both the wheels and the guard rails are preserved. In the large car under discussion the wheel base is only three feet eight inches. The use of four driving wheels actuated by the positive and smooth action of the worm gear offers important advantages in mounting steep grades, and the employment of two distinct motors (one on each truck) decreases the chances of an absolute stoppage to a minimum, because in case of accident to one machine the other is sufficiently powerful to bring the car home. We may mention that all the experiments, and, in fact, all the ordinary every-day runs in the streets with these cars, are carried on in the most systematic manner: a record is kept of the exact amount of energy consumed on any and every part of the lines, and the cost of working is ascertained with the utmost precision.

A New Electric Meter.

The electric motor has already taken a prominent part in the development of electrical power distribution, and one of the strong points in its favor is the ease with which it lends itself to every manner of regulation, whether of speed or power. It was this property which suggested to Mr. Richard N. Dyer, of East Orange, N. J., the idea of applying the electric motor in the capacity of a meter or registering device for recording the quantity of current passing through a circuit. It is evident that if a small electric motor, actuated by the current, can be kept at a speed which will always be proportional to the strength of the current, the number of revolutions recorded will be an

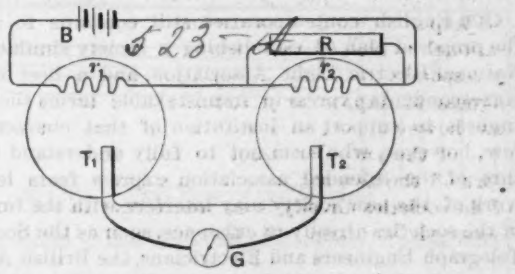


FIG. 1.—A NULL METHOD OF ELECTRO-CALORIMETRY.

exact index of the quantity of current that has passed through the circuit.

The manner in which this idea has been carried out is shown in the accompanying diagram. The meter consists of a small electric motor *B*, the shaft of which is connected to a registering apparatus. The armature *C* of the motor is located in a cross-circuit 3 4 between the positive and negative conductors 1 2 of the circuit, the current of which is to be measured. The field magnet *E* of the electric motor has a high resistance winding *a* which is located in a cross-circuit 5 6 independent of the armature circuit. The winding *a* is the principal winding of the field-magnet and produces the predominating magnetism. The field magnet is also provided with low resistance demagnetizing coils *b*, which are located directly in the line of the conductor 1 or 2 for a house meter, Fig. 1; but for a station meter or for measuring a very large current in any location the demagnetizing coils would be arranged in a shunt around a resistance in the line.

The demagnetizing coils act to decrease the force of the field magnet *E* in proportion to the line current, and the motor armature, which is controlled by this magnet, increases its speed as the force of the field magnet is decreased by the demagnetizing coils. The parts and resistances are so designed that the armature revolves with the smallest speed possible when the minimum current is flowing in the line, the field magnet then having the greatest strength.

It is of course necessary to work well within the saturation point of the field magnet, in order that the rise and fall of the magnetism may be proportional to the current. When one lamp is in circuit the register is driven slowly by the motor; but as more lamps are placed in circuit the speed of the motor increases in proportion to the increased flow of current. The register thus gives an accurate statement of the flow of current, either directly or by deducting the number of revolutions due to the initial speed of the motor.

The motor armature and field being in cross circuit, a

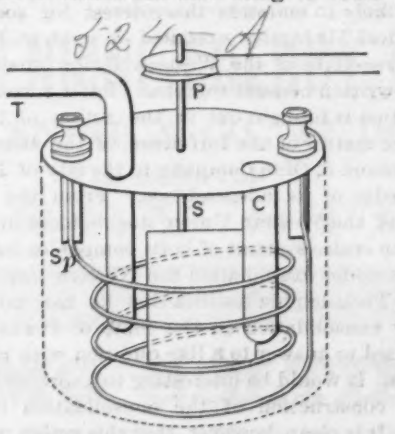


FIG. 3.—A NULL METHOD OF ELECTRO-CALORIMETRY.

constant driving force is obtained, assuming that a constant difference in potential is maintained, and the demagnetizing coils are the only variable factor of the apparatus. The location of the field magnet and armature in independent cross circuits takes care largely of variations in potential, since such variations affect the field magnet and armature oppositely and approximately to the same extent when there is no load. An increase in potential acts on the armature to increase its speed, while the effect of an increase in potential on the field magnet is to increase its strength and decrease the speed of the armature, and hence the speed of the armature will remain the same. This simple arrangement of the field magnet and the armature in independent cross circuits is sufficient to maintain a practically constant speed under the ordinary variations of potential. Another method, however, consists in employing an auxiliary field magnet winding *c*, which is located in series with the armature, and also in series with the main field winding *a*, the latter being in shunt with the armature. This winding *c* will assist the main winding *a* and keep the speed of the motor constant under all variations in potential, except as such variations act to increase the line current, when, of course, the motor responds to the action of the demagnetizing coils. The cross circuits, 3 4 and 5 6, may be connected with the circuit 1 2 between the demagnetizing coils and the lamps or other current consuming device, or outside of the demagnetizing coils.

To prevent waste of current when no lamps are in circuit, there is provided a circuit controller, which acts to close the motor circuits when the first lamp is placed in circuit, and retains the motor circuits closed until the last lamp is turned off, when the circuit controller opens the motor circuits.

This circuit controller consists of a swinging lever *F* of brass, provided with a soft iron core *d* on its lower end and acted on by a main line coil *e*. The lever *F* touches a spring *f*, and closes the motor circuit when the core is drawn into the coil. An adjustable weight *g* throws the lever away from the spring and opens the motor circuit when current ceases to flow in the coil. This circuit controller is designed to be used with each meter having an electric motor for driving the register when the motor has a speed proportional to the number of lamps in circuit; but when the motor has an initial speed, which is necessarily deducted from the register-reading to give the revolutions due to the lamp current, then this circuit controller is not required.

As a practical form it has been determined to omit the circuit controller *F* and to connect the meter with the circuit outside of the house switch. The motor will run constantly at an initial speed of 250 revolutions and a maximum speed of 500 revolutions, the speed increasing from 250 to 500 in direct proportion to the number of ampères flowing in the demagnetizing coils *b*. When the reading is taken to the office the revolutions due to the initial speed will be deducted, and the number of revolutions left will form an accurate basis for the charge. The motor will be

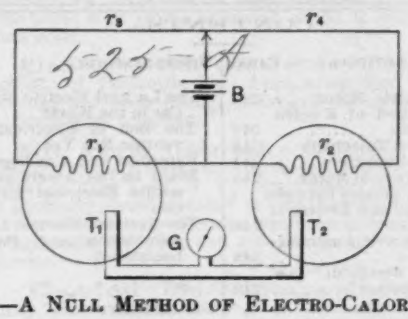


FIG. 2.—A NULL METHOD OF ELECTRO-CALORIMETRY.

protected by a line safety-catch, and will be wound to take in its armature and main field coils *a* only a small fraction of the current of one lamp.

A Null Method in Electro-Calorimetry.*

BY PROF. W. STROUD, D SC., B. A., AND W. W. HALDANE GEE, B. SC.

The idea of introducing heat into a calorimeter by means of an electric current traversing a wire, has been utilized by some physicists for the measurement of the specific heat of liquids. The method employed by Pfaundler consisted in using two identical calorimeters, the one containing water, the other the liquid to be experimented upon. A current was passed through two spirals of wire of equal resistance, the one immersed in one calorimeter, the other in the second. A thermometer in each calorimeter served to measure the rise in temperature. The advantages of heating a liquid in a calorimeter electrically are manifest. Experience with Pfaundler's method both at Owen's College and at Yorkshire College suggested to us independently the possibility of modifying the arrangement so as to obtain a null method.

We realized that a great improvement would be effected by altering the ratio of the strengths of the currents in the two calorimeters in such a way that the same rise in temperature takes place in each, which can be indicated by some form of differential thermometer or thermo-electric combination. We thereby secure not only all the advantages of a null method, but further, the correction for radiation becomes a matter of secondary importance.

The apparatus which is exhibited before the association consists of two equal calorimeters provided with stirrers rotated by clock-work. A thermo-electric pile consisting of ten iron-German-silver junctions in circuit with a suitable galvanometer is used as the differential thermometer, Fig. 1.

Instead of this we have also employed the following method in which a Wheatstone bridge or rheostat is used, Fig. 2.

The thermo-electric arrangement was such that a difference of temperature of $\frac{1}{100}$ of a degree centigrade could be detected. During the adjustment of the resistances in the progress of a determination, the calorimeters are continually rising in temperature. To bring them back to the temperature of the air the following process of cooling has been adopted. Within each calorimeter there is a water-tight cylinder of thin sheet copper. When the ap-

*Read before the British Assoc., Manchester, 1887.

paratus is required to be cooled we introduce into each of these a leaden tube conveying a current of water. This is shown in the Fig. 3.

The method which manifestly possesses many theoretical merits we have found in practice to be susceptible of considerable accuracy. In conclusion we may remark that the application of similar electrical methods to the determination of other calorimetrical questions, such as the latent heat of vaporization of liquids might with advantage be extended.

The Writing Telegraph.

One of the earliest objections raised against the telephone was that it left no written record of the communication, and hence to accomplish this object there was devised a writing telegraph. This system, to which we have already drawn attention in the past, is now in operation at the American Institute Electrical Exhibition and attracts a great deal of attention.

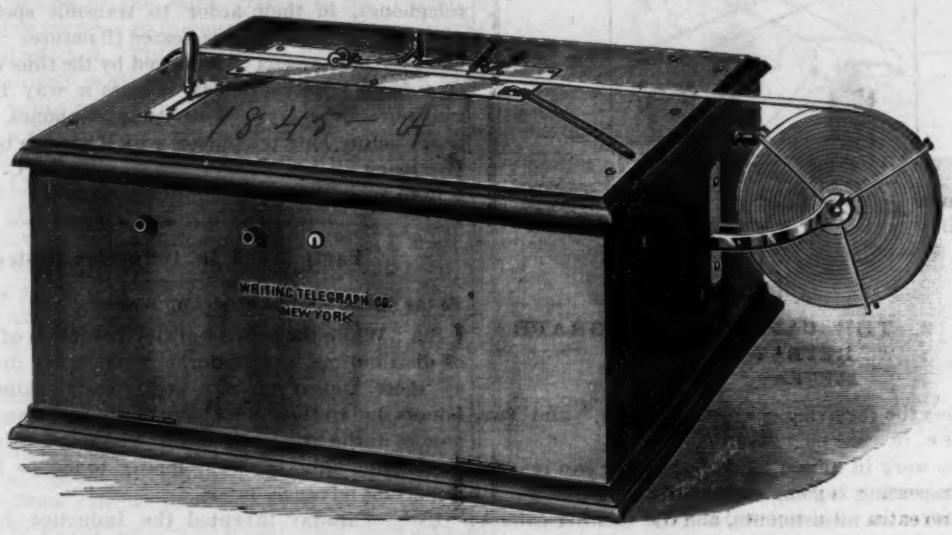


FIG. 1.—THE WRITING TELEGRAPH.

The entire apparatus at the subscriber's office is contained in the instrument shown in the accompanying illustration, Fig. 1. Two wires lead from this to the central office, where the batteries are situated, there being no local batteries required at the subscriber's.

The transmitter, shown enlarged in Fig. 2, consists of two series of thin carbon discs about one-half inch in diameter, placed at right angles to each other, in a hard rubber receptacle. The normal pressure of each series of discs is adjusted by a screw. The stylus rod has insulated pressure points opposite the piles of discs, and is supported at the base on thin wire, so that by taking hold of the handle it can be manipulated, as in writing. Each of these series of carbon discs is in circuit with one of the line wires which are led to the receiver. Fig. 3.

This consists of two pairs of electro-magnets, each in circuit with one of the line wires and placed at right angles to each other. The rod which carries the pen and the armature has a spring wire projection at its base, and is fastened at a point where the poles would meet if extended. The armatures for each pair of magnets have a brass connection and are placed above the cores of the magnets. Above the armature is a German silver float which moves in a cup of glycerine and prevents any tremors appearing in the writing. The pen is a fountain pen and contains an ink which does not dry in the pen, and is always ready to write.

The transmitter and receiver are placed in a case about 14 inches long, 9 inches wide and 8 inches deep. This case, Fig. 1, also contains a bell and the clock-work mechanism which moves the strip of paper. Above the box appears the handle of the transmitting stylus, and the armature rod carrying the pen. On the left is the switch for changing the current from the transmitter to the receiver.

When the stylus of the transmitter is pulled to the right its pressure point presses on the right and left carbon discs, the resistance in the circuits is reduced and an increased current is sent into the corresponding magnets of the receiver, which pulls the receiving rod to the right, in accordance with the strength of the current. A pull of the transmitting rod to the left in the same way pulls the receiving rod to the left, and the curves are the result of a pull, which sends two unequal currents at right angles to each other.

A transmitter is readily adjusted to its receiver, so that the pen will follow every movement of the stylus, stop where it stops and move where and when it moves.

In writing the transmitter and receiver are both in circuit with the receiver of the instrument which is to receive the message. The sender watches only his receiving pen, and, taking hold of the handle of the stylus rod pulls the receiving pen to form what letters he wishes, and the receiving pen of the distant instrument also makes a facsimile of every letter or mark.

It takes but a short time to get used to the moving paper and to form the letters without moving the hand to the right, and that is all there is to learn to operate the instrument.

We thus have a system of written telegraphic messages, and arrangements are perfected to work the same commercially in several cities.

The central exchange instrument and system of the Writing Telegraph Co. will be shortly added to the exhibit. Every one of these instruments can be started and stopped at will from the central office. In from three to five seconds after a subscriber pulls over his switch, which drops the annunciator in the central office, he can be writing his message to the number he has requested. That subscriber is not called up, but the instrument is started from the central office, and the tapping of a bell notifies him that a message is being recorded. If he is in he answers; but if he is away he finds the message sent him during his absence on his return.

Another style of instruments are those designed to report base-ball reports in several parts of a city at the same time. They can also be used for stock reports or other news. This system consists in placing receiving instruments in different parts of a city, all connected with an instrument on which the writing is done, and which starts and stops all the others, their pens writing in unison with the transmitting machine.

The End of Electrical Invention Not Yet.

BY PROF. EDWIN J. HOUSTON.

Having recently obtained a copy of "A Complete Treatise on Electricity in Theory and Practice," by Tiberius Cavallo, F. R. S., published in London in 1795, I find therein an excellent account of the condition of electrical science at that early date. The book includes three volumes, of some three hundred odd pages each, and contains an excellent account of what was then known concerning the science. This, however, was very limited. With some unimportant exception, electrical knowledge had made its most important advance in the direction of what was then called frictional electricity. Galvani had made his famous experiments on the movements of the legs of frogs. Volta was on the verge of his great discovery of the voltaic pile, but had not yet given to the world in a completed condition that piece of apparatus which, so far as its influence on the history of the world's progress is concerned, is perhaps entitled to rank first in importance and value. The chemical effects of electricity were beginning to be vaguely understood. Nicholson and Carlisle had commenced their experiments. Von Kleist had discovered the Leyden jar; Franklin had drawn the lightning from the sky; Davy had not yet made his immortal discovery of the metallic base of potash; Oersted and Ampère were fully two decades from their discoveries in electro-magnetism; Faraday's great discoveries were yet to come.

At about the time of the publication of Prof. Cavallo's work the scientific world had not yet recovered from its astonishment at the curious union of electrical energy noticed in the Leyden jar. In the introduction to his work on electricity, Prof. Cavallo, speaking of the discovery of Von Kleist in 1745 of the Leyden phial, and commenting on the then singularly rapid growth of electrical knowledge, speaks of an apprehension in the minds of some that the end of possible further extension in electrical knowledge had been about reached. Viewed in the light of the present time, the fears embodied in these speculations are so quaint and curious that it has occurred to me that it might not be uninteresting to your readers to quote the passages alluded to. These passages are as follows:

"Since the time of this discovery, the prodigious number of electricians' experiments and new facts that have been daily produced from every corner of Europe and other parts of the world, is almost incredible. Discoveries crowded (*sic*) upon discoveries, improvements upon improvements; and the science ever since that time went on with so rapid a course and is now spreading so amazingly fast, that it seems as if the subject would soon be exhausted, and electricians arrive at the end of their researches. But, however, the *ne plus ultra* is, in all probability, as yet at a great distance, and the young electrician has a vast field before him highly deserving his attention, and promising future discoveries, perhaps equally or more important than those already made."

FIG. 2.
THE WRITING TELEGRAPH.—TRANSMITTER.

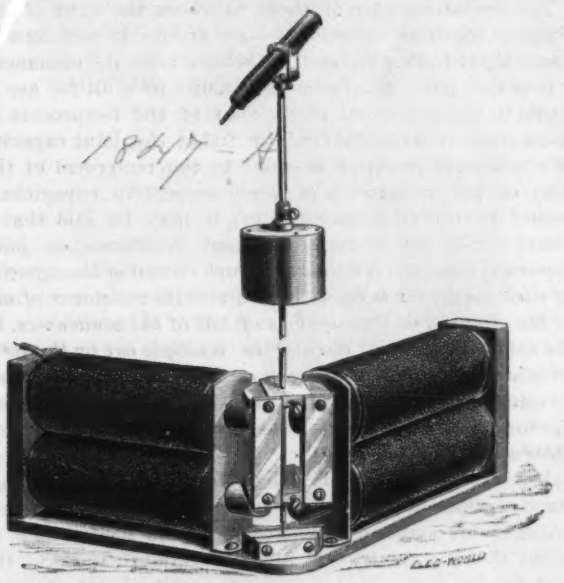


FIG. 3.
THE WRITING TELEGRAPH.—RECEIVER.

Repeaters and Condensers.

BY WM. MAVER, JR.

It is a very trite remark that an automatic telegraph repeater is the first thing that the aspiring telegrapher sets out to invent, regardless of the fact that the demand for such devices is very well supplied, and that the repeaters at present, and for a very long time past, in use, are as simple and inexpensive as they well can be, consistent with efficiency.

Within the last few years I have had at least a dozen visits or letters from such aspirants, submitting devices which, on examination, have proven to be either palpably inoperative or reinventions of some well-known repeater, such as the Toye. Therefore, anything really novel in telegraph repeaters would be so refreshing that my attention was at once arrested by the caption of an article by Mr. W. S. Chesley, in your issue of Oct. 8, entitled "A New Telegraph Repeater." A few moments' inspection of the diagram accompanying the article disclosed the fact, however, that Mr. Chesley's arrangement is not very new.

Mr. R. C. Edwards, if I mistake not, anticipates Mr. Chesley as the inventor of the principle of his repeater by many years, and Mr. J. W. Larish, of Buffalo, N. Y., reinvented it in the fall of 1884. At that time I showed the arrangement to Mr. J. H. Bunnell, an authority on repeaters, who said concerning it, somewhat hyperbolically, that he had been familiar with it prior to the flood. As shown in the diagram, the repeater is a very good fair weather repeater, but those who have used it extensively, employing only the continuity preserving transmitter, avow that it is not reliable on heavy-escape wires. Mr. Larish modified the device to the extent that he kept the opposite transmitter closed by a separate set of contact points, using "pole-changing" transmitters for the purpose, and, as thus arranged, this repeater has been giving good service in the Buffalo office of the Baltimore & Ohio Telegraph Company for several years.

In your editorial comments, in the same issue, on Mr. Prescott's excellent article descriptive of Mr. Marshall's improved standard condenser you are made to say "because the sections of condensers, as usually constructed, could only be connected in "series." It should, of course, have read "in multiple arc." The feature of Mr. Marshall's improvement, I take it, is that the sections may be connected in series or in multiple arc, at will, thereby obtaining, as Mr. Prescott observes, a much greater variety of capacities for testing purposes.

Permit me to offer the suggestion that the rule given by Mr. Prescott for the joint capacity of condensers in series

might be slightly modified to read somewhat as follows: "The available capacity of condensers when charged and discharged in series is equal to the reciprocal of the sum of the reciprocals of their respective capacities." For, if a number of condensers, or sections of a condenser, be charged in series with a given potential, and then discharged singly, or in multiple arc, the sum of such discharges (assuming for the sake of simplicity that the capacity of each condenser is alike), will be equal to the discharge of one such condenser charged with the same potential.

In this arrangement Mr. Marshall takes advantage of the interesting law that the fall of potential is in proportion to the number of condensers in series. Consequently the

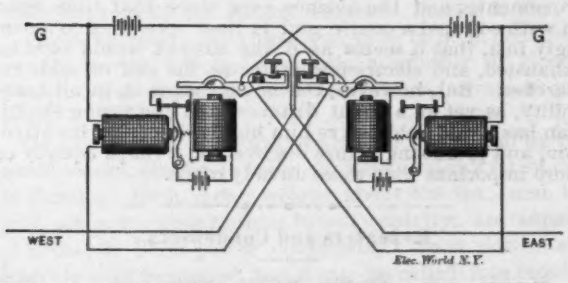


FIG. 1.—CAPWELL AND GILMAN'S TELEGRAPH REPEATER.

difference of potential between the inner and outer plates of each condenser in the series is equal. For instance, if 10 condensers are in series with a "charging" potential of, say, 10, the difference of potential between the inner and outer plates of any one condenser will be 1. And as the charge accumulated in a condenser is equal to its capacity multiplied by the difference of potential, it explains why the sum of the discharges of the condensers, which have been charged in series, when discharged singly, or in multiple arc, will be equal to one of the condensers charged singly with the original potential. It also explains why the available capacity of the 10 condensers charged as above with a potental of 10, and discharged in series, will be only one-tenth that of one of the condensers charged by the same potential. For (still assuming equal capacities for each condenser or section thereof), inasmuch as the charge of the outer plates of the first condenser in discharging neutralizes that of the inner plates of the second condenser, then the outer plate of the second condenser, then that of the inner plates of the third, and so on, there is left available but the charge accumulated by the inner plates of the first condenser and the outer plates of the last condenser; and as this charge is due to a difference of potential of 1, the available charge is of course equal to the charge which would be accumulated by one of the condensers charged singly with a potential of 1. That is, $\frac{1}{10}$ of the charge of any one of the above condensers charged in series by the given potential of 10.

For the information of those to whom the sight of the simplest algebraic equation in an article is sufficient to cause them to skip it, and to whom also the statement "that the joint resistance of circuits in multiple arc is equal to the reciprocal of the sum of the reciprocals of their respective resistances," or "that the joint capacity of condensers in series is equal to the reciprocal of the sum of the reciprocals of their respective capacities," would be rather unsatisfactory, it may be said that a simpler rule for finding the joint resistance or joint capacity, *when the resistances of each circuit or the capacity of each condenser is equal*, is, to *divide the resistance of one of the circuits, or the capacity of one of the condensers, by the total number of circuits in multiple arc or the total number of condensers in series.* For example, supposing 10 circuits in multiple arc, 1 ohm each; joint resistance, $\frac{1}{10}$ ohm. This is, of course, the foregoing, somewhat more abstruse, rule worked out.

Much credit is certainly due to Mr. Marshall for the high state of efficiency to which he has, practically unaided, brought his standard condensers. It is well known to many that his condensers are fully equal to those of the best foreign make, both as regards accuracy and retention of charge, and this latest improvement in the manner of connecting the plates renders them superior to the latter in respect of the possible variations of capacities with a given number of sections.

Telegraph Repeaters.

BY CH. C. CAPWELL.

So much having been said of the Chesley repeater arrangement shown in THE ELECTRICAL WORLD of Oct. 8, the following, devised last summer by Mr. N. A. Gilman and the writer, may be of interest to your readers.

Two single transmitters are used as shown in Fig. 1. An extra local battery is so arranged on open circuit that, for example, when the "western" sounder opens the "eastern" circuit it closes the extra local circuit through the "eastern" relay, thus preventing a "break" in the transmitting side except intentionally by the receiving operator. The poles of the extra local battery should be so arranged as to avoid reversals of current through the relay magnets. In weather requiring high adjustment the extra local may be increased as desired. This is similar to Marean's arrangement except that the main battery and resistance coils are omitted. It works successfully in practice.

Another arrangement devised by the writer is shown in Fig. 2, using the double transmitter slightly altered to suit the circumstances. No extra locals are necessary. The main batteries are omitted from the diagram. When properly adjusted the points D_1 D_2 close slightly in advance of the opening of points C_1 C_2. If "west" opens, circuit S_1 opens, first maintaining the circuit through S_2; then it opens the eastern relay by C_1. Sounder S_2 cannot open with its relay because of D_1.

Thus "west" can repeat into "east" without interruption, unless the receiving operator "breaks," and *vice versa*.

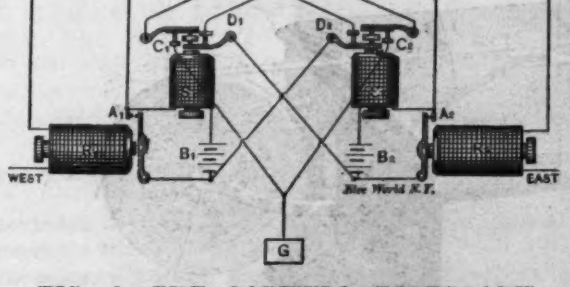


FIG. 2.—THE CAPWELL TELEGRAPH REPEATER.

Both relays work in unison, and the operator can readily see that the repeating is going on properly.

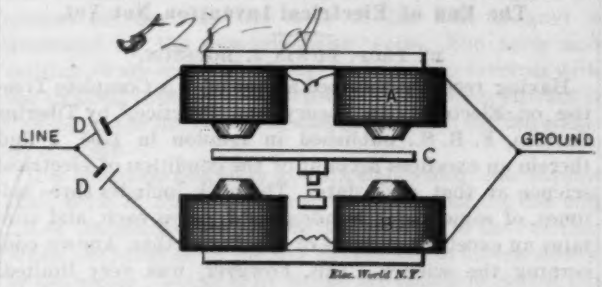
There are no extra adjustments, and the weather cannot interfere with the working more than with the ordinary relay everywhere in use.

High Speed Telegraph Relays.

To the Editor of The Electrical World:

SIR: I have been very much interested in reading the article of Mr. Wm. H. Preece in THE ELECTRICAL WORLD of Oct. 8, entitled "Fast Speed Telegraphy."

The method of overcoming the retardation of the



FIELD'S HIGH SPEED TELEGRAPH RELAY.

electro-magnet in the receiving instrument is identical with the arrangement shown in my U. S. patent No. 353,128, dated Nov. 23, 1886. I have used the shunted condenser in telephone work with success, and thus eliminated the spark due to the extra current from the coils of the telephone or induction coils used with a make-and-break transmitter. I am inclined to think, however, that the arrangement shown in the accompanying diagram will prove to be the better apparatus for high-speed telegraph relays:

A and *B* are two small electro magnets, the cores of which are made of ferrotype plate rolled up. Between the poles of these magnets a soft iron armature *C* is pivoted. A local battery *D D* is included in the circuit of the two electro-magnets which serves to polarize the iron cores to any desired extent,—an approximate equality with that afforded by the line current being desirable. A line current serves to increase the magnetization of one pair of coils, and simultaneously diminish that of the others, with consequent movement of the soft iron armature *C*. Such an arrangement should present the least possible amount of magnetic inertia to an arriving signal.

Let us suppose a zinc current arriving over the line. This would strengthen *A*, and weaken the magnet *B*. *A*, in strengthening, gives off a zinc while *B* in weakening will give off a copper counter current, and these two extra current polarities should neutralize each other.

Another advantage to be derived from this form of relay is the small mass of magnetic metal necessary, a feature which cannot be too highly valued in dealing with high speed apparatus.

STEPHEN D. FIELD.

YONKERS, N. Y.

A Cheap Condenser Wanted.

To the Editor of The Electrical World:

SIR: I want to experiment with an artificial cable, and ask if you or any of your numerous readers will inform me how to construct one so as to exhibit the "retardation" of a cable similar to one of the Atlantics. The material should be simple, as we have no electrical supply company here.

B.

The Pyromagnetic Motor and the Telephone.

To the Editor of The Electrical World:

SIR: In regard to the priority of application of the pyromagnetic principle, I would say that all claimants thus far have been unconsciously anticipated. It was first employed, it seems to me, when the inventors of primitive telephones, in their ardor to transmit speech, evolved phrases of a more or less heated (!) nature. It is easy to trace the phenomena (!) produced by the thus varied coercitive force. But, seriously, here is a way to evade the "diaphragm" feature of existing telephones, and I expect to see before long telephones which have to be lighted before using.

C. M. SAMES.

ROCKFORD, Ill.

Early Work in Induction Systems.

To the Editor of The Electrical World:

SIR: While the subject of the invention of the system of distribution by transformers is under discussion, and as there appear to be a good many claimants for the honors due to those who have really made substantial advances in the art, I may be allowed to give here a few of the leading dates of what appear to me to be the most important advances made.

1835.—Faraday invented the induction coil, open and closed magnetic circuit.

1856.—Cromwell Fleetwood Varley perfected the closed magnetic circuit transformer, making the iron inclose the conductors and thoroughly laminating the iron; patent No. 3,059.

1857.—C. W. Harrison proposed to use induction coils, in a patent granted to him; he proposes to use a primary circuit to supply the coils and to work lamps from the secondary circuit.

1877.—M. P. Jablochkoff patented the use of induction coils in a primary circuit containing the coils in series order and working lamps from the secondary circuit.

1883.—Mr. Rankin Kennedy, of Glasgow, in the *Electrical Review* of London, pointed out the cause of the failures with coils in series order and stated that if placed in parallel order they became self regulating.

1885.—Messrs. Zipernowski & Deri patented the use of coils in parallel order.

These dates have been mentioned by Kennedy in his pamphlet and others as the leading ones, and, if correct, would seem to support his view that no "master patent" exists on the subject.

ROBERT MITCHELL.

KELVINBRIDGE, Glasgow.

A Wonderful Wire Joint.

To the Editor of The Electrical World:

SIR: As illustrating some of the work done under the name of electrical construction by so-called "experts," I inclose a sketch of a joint taken recently from one of the most important posts of the Signal Service of the country, the summit of Mount Washington. The joint itself, which I also inclose, was from a wire recently abandoned, and is probably a fair sample of hundreds of joints in the insulated conductor spiked to the timbers of the railroad by metallic staples. Numbers of these I examined without finding a single one soldered, and in scores of places the insulation was cut through by the metal. The only wonder is that

A WONDERFUL WIRE JOINT.

this line, on which so much depends in winter, is not more often interrupted, and we find in instances like these, which would make electrician Haskins, of Chicago, weep, another evidence of the wonderful manner in which this potent agent serves us under the greatest difficulties.

NEW YORK. J.

The accompanying illustration is a true reproduction of the joint as it was cut from the wire. The wire is insulated by gutta percha, and the joint was originally inclosed in rubber tubing. When cut from the circuit, however, the tubing, as shown, was torn away, completely exposing the joint. The latter, as will be seen, was made by giving the ends a few irregular turns without any twisting whatever, with the result that the two ends are quite loose and rattle when shaken. That any signal at all could be gotten over such a line is a marvel. It will be remembered that not long since it was reported that the Weather Bureau had decided to abandon the Mount Washington Observatory in winter, and if the difficulty of communication was one of the reasons, the cause therefor is now apparent.—EDS. E. W.

The Card Electric Motor.

We illustrate in the accompanying engravings two types of motors designed by Mr. Geo. F. Card, and recently brought out by the G. F. Card Manufacturing Company, of Cincinnati, O. These machines are of the bi-polar type with Gramme ring armatures.

The constant potential motor, type "B," shown in the engraving, Fig. 1, is wound for a current of 2½ ampères, the field and armature being in series. With a current of 1½ ampère the motor attains a speed of 5,000 revolutions per minute. It measures 6 × 7½ inches, stands 5 inches high and weighs 9 lbs. without the base. A resistance box of lamps, of lower voltage than the dynamo, arranged in parallel, is used on the incandescent circuit. By turning them out singly and increasing the resistance the speed of the motor can be reduced at will. By the use of a larger number of lamps of the same voltage as the dynamo, a corresponding increase in the number of variations in the speed can be effected. The current can be thrown off from the motor entirely, without disturbing the lamps, and then their light, being nearly up to full candle-power, can be utilized by a reflector. It will be noticed that in this type of motor, besides the usual field magnets an additional branch is added which arches from pole to pole and encircles one of the bearings of the shaft.

The constant current motor, illustrated in Fig. 2, is series wound and is designed for a current of five ampères and to run at a speed of 5,000 revolutions per minute. In order to be able to operate the motor on a 10 ampère circuit, a shunt resistance of carbon is employed, by means of which five different speeds can be obtained.

One of the features of the Card motors is the reversible commutator, shown at the side of the armature in Fig. 3. This is so arranged that all the sections can be removed and replaced without disturbing a wire. If worn on one face the sections can be reversed, or if worn on both faces, so as to be serviceable no longer, new ones can be inserted. The inventor, after an experience of nearly a year with a dynamo of considerable size, in which this form of commutator is used, claims that the uneven wear on the brushes, which might be supposed to interfere with the practical workings of the device, is an entirely negligible quantity. This arrangement of the brushes also

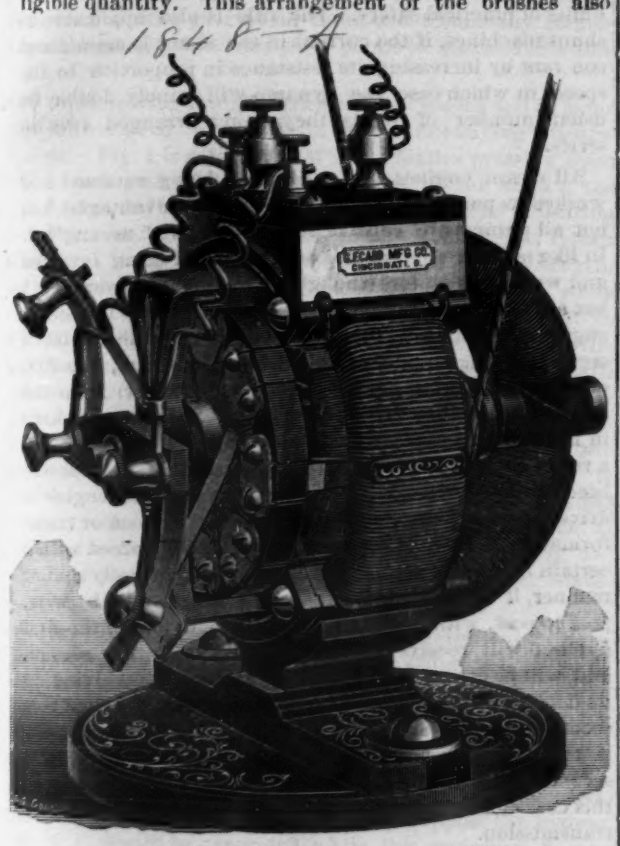


FIG. 1.—THE CARD CONSTANT POTENTIAL MOTOR.

admits of an observation being taken on both brushes at the same time, which is convenient in setting the same.

Notes on the American Institute Electrical Exhibition.

We continue below our notes on the display at the Electrical Exhibition.

THE DAFT ELECTRIC LIGHT COMPANY.

Among the most prominent exhibits at the Electrical Exhibition is that of the Daft Electric Light Company, in which special pains have been taken to show only such apparatus which is in actual daily operation.

The space occupied by the exhibit is rectangular, and at each corner stands a pole of the type used in the Daft system of overhead conduction. Two of these are of wood and identical, except in height, with those employed at Los Angeles, Cal., Mansfield, O., and elsewhere, and two are of iron, and the same (also reduced in length) which were erected in Orange, N. J. Wires are strung upon the insulators of standard type, at the extremity of the pole-arms, and upon them are the actual "trolleys" or travelers that are used upon the majority of the Daft street railways in this country. The only deviation from actual practice in this arrangement is a diminution of the size of wire consequent upon the short span and unavoidable instability of poles in such a position, which prevented a proper setting taut of wire of the normal dimension. Current is supplied to this quadrangular overhead circuit from a dynamo in a remote part of the building, and one trolley delivers it to a street railway car placed on the floor below. The other trolley delivers current to the various motors and a few lights ranged opposite to the car.

These motors are of standard sizes, and, inclusive of one placed on a table, range from ¼ to 8 horse-power. They are available for all kinds of work, such as driving printing presses, elevators, machine tools, etc., to which it is customary to belt them rather than build them together as

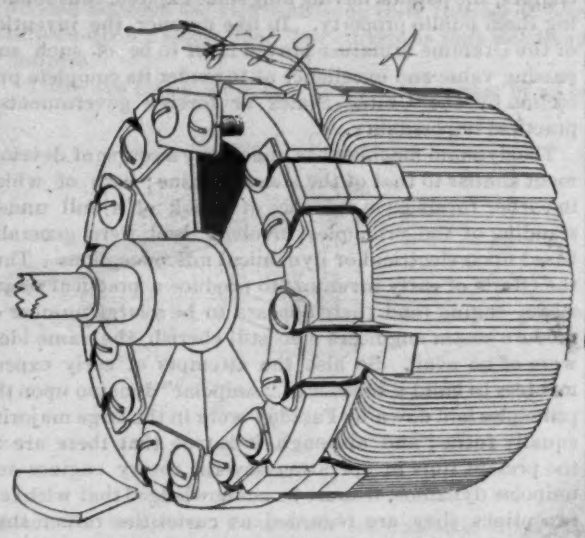


FIG. 3.—ARMATURE OF CARD MOTOR.

compound machines. An exception to this is found in the effective and ready combination of a motor with a Sturtevant blower, whose regularity and scope of adjustment is shown by an india-rubber ball sustained at various elevations dependent upon the speed of the blower.

The car exhibited is one belonging to the Seashore Electric Railway Company, of Asbury Park, N. J., and became available for exhibition through the substitution of closed for open cars with the approach of cold weather. It is raised sufficiently to permit the motor to turn the wheels, to reverse at will and to display the manner in which the driving current lights the car, rings the gong, etc.

A full-size model of the conduit in use on the Pittsburgh, Knoxville & St. Clair Electric Street Railway, at Pittsburgh, Pa., shows the method of subterranean conduction employed in such cases: and another of the "central rail" system, employed for over two years on the Baltimore & Hampden line of Baltimore, Md., illustrates an easy and effective means of obtaining surface conduction.

A table on the southern side of the space has attached to it a section of the conductor, recently laid on the Ninth avenue line of the New York Elevated Railroad, and also displays "trolleys" both for an "all-wire" and for a "wire-and-rail" circuit. There is also exhibited a "limit-switch," the device employed in connection with stationary motors to prevent an undue use of current on the part of consumers. This may be set to any desired limit and operates automatically, opening the circuit the moment the proper current is exceeded.

An example of portable machine tools is also shown in the shape of a breast-drill, which is driven by a diminutive motor attached to the handle. The pressure upon the drill completes the circuit, and a man can carry a quarter of a horse-power with him into any place where he can squeeze his body—as, for example, the interior of a boiler—and draw the current leads after him. He can also have light for his work without vitiating or overheating the air of the most confined space. This is only a first step into a field whose extent can hardly be imagined.

On the south side of the building the old electric locomotive "Ampère" draws a platform car up and down a track some 300 feet in length. This motor possesses the historic interest of being the first, it is claimed, that ever ran upon an actual railroad track in this country, its first public appearance being upon the "Saratoga, Lake George & Mount McGregor Narrow-gauge Railroad" in November, 1883. With the exception of making good the deterioration of four years' disuse and exposure, it is precisely the same machine that there demonstrated the practicability of electric propulsion, and is shown rather as a milestone in its progress than for any other reason.

As before stated, the design of the entire exhibit has been to exclude anything of a purely experimental nature, and to show only what is actually built and in commercial use.

The exhibit will be added to as the exhibition proceeds.

THE WASHBURN & MOEN MANUFACTURING COMPANY EXHIBIT.

The exhibit of the Washburn & Moen Manufacturing Company, of Worcester, makes an excellent display of their iron, steel and copper wire, with express reference to the requirements of electric service. A handsome black walnut cabinet, fifteen feet in height, contains as its principal feature a pyramid of these goods skillfully arranged. One of its most marked features is a superb coil of copper wire, size 000, Brown & Sharpe gauge, which is made up in weights of 2,500 pounds, or nearly one mile and a half in length. All varieties and gauge sizes of copper wire are shown, both hard drawn and soft, the former for the most severe line service. Some of this wire is of hair-like fineness for delicate conductors of electricity such as are coming into common use in the community, in the almost universal applications of electricity to the conveniences of modern life.

The old standard lines of galvanized iron and steel telegraph and telephone wire, most common in the aerial line service, have long constituted a leading staple of the Washburn & Moen Company, whose founding in 1831 antedates the electric telegraph by several years, and has made their connection with the electric service continuous from its first employment in this country. The first working telegraph was known in England in 1839. Morse's first telegraph line was built in 1844, and was attempted with copper wire as the metal best known to electricians. It proved too weak a material and was replaced by the aerial line of iron wire, essentially the same as is in use to-day for the bulk of the telegraph and telephone line construction in this country. Some of the earliest constructed telegraph lines in the United States were built with wire furnished by the Washburn & Moen Company, and were still in use not many years ago.

The telephone has come later, but only to require almost the same qualities that mark good telegraphic wire.

Within a few years the wonderful growth of the electric service in other fields than those above named has opened a new draft on the wire industry, for copper wire, such alone being employed in service of the electric light and electric motor where powerful currents are to be dealt with and generally at comparatively short distances. For such service copper only and this of a high quality can be employed. The Washburn & Moen exhibit on this occasion is very rich and strong in its illustration of this form of electric supply.

A further word deserves to be said for the features of the same display incident and contributory to the electric

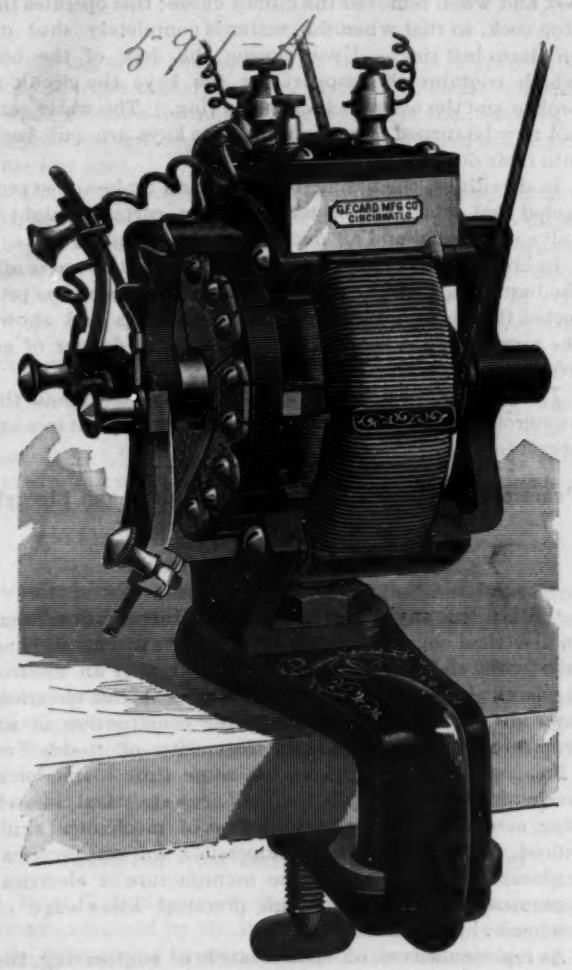


FIG. 2.—THE CARD CONSTANT CURRENT MOTOR.

service which itself has become so universal as to lay under wide tribute all the domain of the mechanic arts. The Washburn & Moen Manufacturing Company make from 150 to 200 varieties and styles of wire, and in numerous instances have come to advance their styles to developed products; for instance, all varieties of springs are shown, from the delicate watch spring to the stronger springs useful in various mechanisms. A very notable part of their product is illustrated in this display, in connection with events of recent interest, the wire standing rigging made by this company for the successful American yachts in the contests of 1886 and 1887. All varieties of cable work and cordage are made at the Worcester mills.

THE SILLIMAN CONDUIT.

The new conduit exhibited by Mr. R. F. Silliman, of Troy N. Y., is designed to to carry telegraph, telephone and electric light wires and cables, independent of subways. The conduit is laid in sections, say, 10 to 20 feet each, of iron pipe, similar to gas or water pipe, with the wires equidistant from each other and filled solid with an effective insulating material costing two cents per pound. These pipes are laid in trenches, and each wire fits tightly into a coupler half an inch in length, and each pipe is bolted to the other by four large screw bolts, making the whole system impervious to water or damp. Two rubber gas-

kets are used between the flanges, and the insulating material is waterproof. The pipes are prepared and finished either at the manufactory or where they are to be laid, and they can be put together in a very short space of time after the trench has been dug. The conduit is so designed that companies or persons can make the cable or conduit near where it is laid. It requires very little digging, and the pavement can be put back at once in a permanent manner; by its construction it saves the necessity of drawing wires in and out. Any wire can be taken out at the end of every section for use in buildings, the wires coming out between the two gaskets, and the latter compensate for the contraction or expansion of the cable.

The inside of the coupler is beveled so that the wires in the opposite section will find their way into the coupler should they be slightly out of line. Templets are used to hold the wires in tension until the pipe is filled, and each one fits every other pipe in the street, and the insulating material fits face to face. Forty-five wires, half inch from centre to centre, are put in a 4-inch pipe; but one hundred can be put in if necessary. One hundred and ten wires can be put in a 6-inch pipe, and over 300 in a 12-inch pipe at a distance of half an inch from centre to centre; and 220 and 600 respectively can be put in if required.

The inventor claims that a branch can be taken off at any point, or a turn made at any corner; also that the conduit can be led to the highest stories of a building, and the wires and pipe kept intact until they arrive at their destination.

Mr. Silliman has a model in the Exhibition which he says shows an insulation resistance of 4,230 megohms per mile, but he is constructing a larger model, and promises even better results in the near future.

THE ELECTRIC WATER PROTECTIVE COMPANY.

The system which is shown in operation by this company is designed to automatically shut off the water in business houses when the premises are closed.

The store keys are suspended from a support within a box and when removed the circuit closes; this operates the stop cock, so that when the water is completely shut off an alarm bell rings. Upon closing the door of the box which contains the support for the keys the circuit is broken and the alarm bell ceases to ring. The water cannot now be turned on again unless the keys are put back into their designated place.

In dwellings, the basins, bath tubs and tanks are so protected that when the water reaches a certain height a valve is operated and an overflow thus prevented.

In hotels, where it is not advisable to shut the water off, the basins and bath tubs in the different rooms are so protected that the annunciator in the office rings and shows the number of the room in which there is danger of an overflow.

Leaks in pipes are detected by this system, and the numerous cases of water overflows and consequent loss are prevented.

Practical Analogies between Mechanical and Electrical Engineering.

BY H. FRANKLIN WATTS.

I.

"It is a true saying, and worthy of all acceptation," that an electrical engineer is about eight-tenths mechanical and two-tenths electrical. A dynamo is in reality an electro-mechanical machine, in which mechanical and electrical laws are intimately associated; the construction of an armature so as to avoid the formation of "eddy" or "Foucault" currents, and at the same time to render it mechanically strong, calls for sufficient electrical knowledge, combined with a high degree of mechanical skill. Indeed, it would be utterly impossible for an electrical engineer to be successful in the manufacture of electrical apparatus without a thorough practical knowledge of mechanical laws and appliances.

As representatives of each branch of engineering, the steam engine and dynamo machine stand as respective types, and, as they are in nearly all cases placed side by side, it becomes an easy matter to study their construction and points of resemblance, and it is between these two machines that a large majority of the following analogies exist.

A steam engine resembles a dynamo machine not only in its mechanical construction and attention necessary to operate, but also in the calculations of its theoretical and actual performance. On some few points they also differ greatly. Thus, a steam engine utilizes the expansive force of an invisible vapor, steam, to produce visible mechanical motion; while the function of a dynamo is precisely the reverse, viz., the transformation of visible, mechanical motion into the energy of an invisible, subtle fluid, electricity.

It is a singular fact that the electric motor is older than the dynamo machine and dates from 1833, long before the discovery of the reversibility of the motor or dynamo. So also the steam pump is older than the steam engine; in fact, the first engine built by James Watt in 1774 was a pumping engine. The first dynamo-machine was made by Michael Faraday about the year 1831. Thus the names of Watt and Faraday stand pre-eminent in the early history and development of the steam engine and dynamo machine.

Of later improvements, Mr. George H. Corliss has done for the steam engine what M. Gramme has accomplished for the dynamo machine, the celebrated "wrist motion" of one being analogous to the closed ring armature winding of the other. As is too often the case, neither inventor reaped the just fruits of his labors, and Mr. Corliss suffered greatly under the open and deliberate infringement of his patent rights and the natural results of prolonged litigation which, however, ultimately demonstrated to the public the high value and vitality of the Corliss patents. His improvements in engine valve gear together with subsequent modifications are now adopted and used by nearly all builders of first-class large factory engines, the patents having long since expired, thus rendering them public property. In like manner the invention of the Gramme armature proved itself to be of such surpassing value and excellence as to render its complete protection by the United States or foreign governments a practical impossibility.

The dynamo machine has undergone a course of development similar to that of the steam engine; both of which in earlier forms gave evidence of a lack of a full understanding of the principles involved, and were generally based upon electrical or dynamical misconceptions. Thus the efforts of early inventors to produce a practical rotary steam engine (and there appears to be a large number of modern steam engineers who still cherish the same idea) were of no avail. So also the attempts of early experimenters to build a successful "unipolar" dynamo upon the principles laid down by Faraday were in the large majority equally futile; and although it is true that there are at the present time in operation several rotary engines and unipolar dynamos, it must be acknowledged that with few exceptions they are regarded as curiosities rather than practical machines. The dynamo of Prof. Geo. Forbes appears to be a brilliant exception.

The forms and types of steam engines are fully as great and varied as those of the dynamo machine. In the latter we have the single magnet (salient pole), the double magnet (consequent pole), the stationary armature, the revolving armature, the multipolar dynamo, the high pressure (arc lighting), the low pressure (incandescent lighting or metallurgical work), and the compound dynamo. In steam engines there are also the single engine, the double engine, the stationary cylinder, the oscillating cylinder, the multicylinder, the high pressure, the low pressure and the compound engine. To complete the analogy, there is also the revolving cylinder engine, in which three cylinders coupled to the periphery of the fly-wheel revolve around a stationary crank. In steam engines, the pressure in the cylinder is four or five pounds less than that indicated by boiler gauge, depending upon the length and size of connecting pipes between engine and boiler, and is due to friction, condensation, etc. Similarly in a system of incandescent lights the lamps placed at a distance do not receive the full potential of the machine, but suffer a certain percentage of loss due to the resistance of the circuit.

In a dynamo the total electromotive force is (or should be) distinguished from the "D. of P." (difference of potential) at its terminals; the former can only be obtained by indirect calculations which are of little commercial value, while the latter can be directly measured and represents the useful or available E. M. F. between the binding-posts or points at which the current enters and leaves the machine. So also in a steam engine, the *total* pressure should not be confounded with the *useful* pressure; the first is indicated by gauge, while the latter can be obtained only by comparing the pressure of the supply pipe with the pressure of the exhaust pipe, or by the indicator. This difference of pressure between the points where the steam enters and leaves the cylinder represents the available pressure upon the piston. It would perhaps be more convenient to fit a thermometer in the supply and exhaust pipes and thus obtain their differences of temperature, which is equivalent to a difference in pressure. The steam gauge is analogous to the voltmeter, and is connected to the boiler by a small pipe which may be of almost infinite length (horizontally) and requires no steam to be conveyed, but merely the pressure to be transmitted; this pipe is often made into a coil to condense the steam before reaching the gauge. The voltmeter is also connected to the circuit or dynamo to be measured by very small wires which may be of nearly infinite length, as there is but little current to be conveyed, the instrument being wound with a coil of high resistance. The ammeter used to measure the whole current generated by a dynamo is placed in the main circuit, and is of extremely low resistance. An instrument somewhat similar to this—the steam meter—was formerly used by the New York Steam Company to measure the quantity of steam consumed by customers. This was placed in the main supply pipe, and was of such construction as to allow the free and unobstructed passage of steam, or as gas meters are now arranged. A very small pipe or tube is capable of sustaining an enormous pressure, due to its small internal sectional area upon which pressure can act, but will convey but a very small quantity of fluid.

So also a No. 40 platinum wire is capable of transmitting a potential of 50,000 volts (as far as E. M. F. alone is concerned, enough to maintain over 1,000 arc lamps in series), yet this wire would fuse and vaporize if a few ampères of current were passed through it.

In operating steam under very high pressures (1,000 pounds has occasionally been employed), certain difficulties are experienced. 1. For the same size of boiler it necessitates a thicker shell and hence a more indirect application of heat to the water. 2. Pressure upon the surface of the water in the boiler raises its boiling point. Under atmospheric pressure it will boil at 212 degrees F., but under a pressure of 1,000 pounds, the water must be heated to about 900 degrees F. before boiling will commence. 3. High pressure of steam also means a correspondingly high temperature. Under a pressure of 1,000 pounds, the temperature of the steam is the same as the boiling point of the water, about 900 degrees F. Such a high temperature rapidly burns the oil and packing of the engine, and renders lubrication of the valves difficult. It is needless to add that it is also exceedingly dangerous.

In operating electricity under extraordinary E. M. F.'s (as high as 6,000 volts, as has been employed by Deprez in his experiments at Creil and Paris), a like number of difficulties are present. 1. High E. M. F. means a great length of fine wire upon the armature, which is both expensive and has a high electrical resistance, and hence low economy. 2. In all the convolutions of wire upon an armature a certain percentage is necessarily idle and, as in a high potential machine, the number of convolutions are very many, so also the ratio of idle to useful wire is proportionately great. In this we have also the explanation why high potential machines are less efficient than low potential ones—due to higher internal resistance and greater length of wire not under induction. 3. High potential necessitates very high insulation and a greater liability to burn out the armature in consequence of a short circuit. It is also exceedingly dangerous to handle.

Large engines are more efficient than small ones; so also are dynamos. An engine running at 75 revolutions per minute and developing 100 h. p. can be made to give out 200 h. p. if its speed is increased to 150 turns; or, in other words, by doubling the speed of the engine we also double the h. p. produced. This is equally true of dynamos. A series wound arc machine feeding 30 arc lamps at its normal speed of 800 is capable of supplying 60 arcs if its speed is increased to 1,600, provided, however, in both cases this increase of speed is contained within the limits of practical safety. The rule is also applicable to shunt machines, if the current in the shunt is maintained constant by increasing its resistance in proportion to the speed, in which case the dynamo will supply double its usual number of lights, they being arranged two in series.

All steam engines are capable of being reversed and worked as pumps (though with some disadvantages), but not all pumps are capable of being worked as engines. In like manner all dynamos are capable of being reversed and worked as motors (though with some disadvantages), but all motors cannot be worked as dynamos. If a steam engine be connected by belt, pulley to pulley with a second driving engine, or one driven by steam, the first engine will receive energy (mechanical power) from the second, and will be driven as a pump, its piston working in its cylinder acting as such, and may compress air into a reservoir, and from thence be transmitted to great distances with small loss, to be used by a second engine to drive a second pump, and so on; each conversion or transformation of energy, however, being accompanied with a certain inevitable percentage of loss. In a precisely similar manner, if an ordinary dynamo is connecting by wire, post to post, with a second generating dynamo, the first dynamo will receive energy (current) from the second, and will be driven as a motor (its armature revolving in its field acting as such), and this motor may be belted to a second dynamo, which may generate current and transmit it to great distances, with small loss, to be used by a second motor and so on, the percentage of economy in this case closely approximating that present in pneumatic transmission.

If two engines are connected together by pipe, as described above—the exhaust of one with the supply of the other—the first engine being driven by belt and acting as compressor to operate the second, acting as an engine, the second engine will run backward, or in an opposite direction from which it would run when supplied by steam under ordinary conditions. To render the direction of motion similar in both cases, the position of the valve must be reversed with reference to the piston. So also if two series dynamos are connected by wire, the positive of one with the negative of the other, the first dynamo acting as generator and driving the second as motor, the motor will run backward against its brushes, or in a direction opposite to that in which it would revolve when working as a dynamo. To render the direction of rotation similar in both cases, the connections of the armature must be reversed with reference to the field-magnets.

In general terms, the most perfect dynamo will also become the most efficient motor, but the reverse is not true; neither is it true that a good engine will constitute a first-class pump, or *vice versa*. In a steam engine the valve-gear is usually driven from an eccentric upon the main shaft, and therefore absorbs a certain proportion of the power developed by the engine. In a dynamo the current necessary to produce the field magnetism is derived from the total output of the machine. If the valve or valves of an engine are unbalanced or otherwise of bad construction,

then the unbalanced pressure of steam will cause great friction upon its seat and a correspondingly large amount of energy will be required to move it. This is analogous to a dynamo in which the magnet or magnets are not of good design (generally in the arrangement of iron masses) and which require a large current to maintain them.

The Porter-Allen and Corliss engines may be regarded as standard types of first-class modern steam engines, yet it is only under the most favorable conditions that these engines (single non-condensing) can utilize 60 per cent. of the heat energy passing through their cylinders, notwithstanding the many claims to the contrary, while in the large majority of small engines the economy is scarcely 40 per cent. There are few commercial dynamos now in use having an efficiency of less than 80 per cent., while one or two exceptional forms utilize as high as 92 per cent. of the power delivered to their pulleys. This is a fact to the credit of the electrical fraternity that a dynamo is a far more perfect machine than a steam engine. In a dynamo, the loss is due to resistance of conductors, armature reactions, generation of "eddy" currents and consequent heating, etc. In a steam engine, the loss arises from condensation in pipes and cylinder, mechanical friction, leakage, etc. But far more important still in giving prominence to this enormous waste, is the fact that, as the steam leaves the cylinder through the exhaust pipe into the atmosphere, it is still under a high temperature and pressure, and it is not until the expansion can be carried down to the atmospheric line that the efficiency of the steam engine can rise above its present figure.

This, as I have long maintained, is the only true method of working steam, viz., carrying the expansion down to that point which will enable the engine to make a complete stroke without exhaust.

In a single engine there are two points of the revolution at which the piston has absolutely no power to revolve the shaft, called the "centres" or "dead centres." There are also two other points of the revolution at which the power of the piston to revolve the shaft is at a maximum, called the "half centre," "half throw" or "quarter."

In dynamos there are also two points of the revolution at which any one armature coil is generating no current or E. M. F., and two other points at which the greatest current is being generated; these are technically termed the "neutral points" and the "points of maximum induction."

In comparing the analogies between engine and dynamo just mentioned, let us refer to the accompanying illustrations. Fig. 1 is a diagram of the effective pressure upon the crank-pink P at different portions of the stroke, the height of the curve above the horizontal line indicating the forward stroke and the lower that of the return stroke. If the connecting rod R were of infinite length, the pressure upon the crank-pin would be greatest while passing the "quarter" or "half centres" at C and C', as indicated by the dotted curve. In practice, however, the connecting rod R is not of infinite length, but of a length having a known ratio to that of the crank. In the diagram the connecting rod is two and one-half times the length of the stroke, or five times the length of the crank, which is about the usual length used. It will be seen that in this case the point of greatest rotary effort no longer coincides with the position C C', but is moved backward to the points 77 and 103 degrees, instead of 90 and 90 degrees as before, in consequence of the shortness of the connecting rod.

Fig. 2 is a diagram illustrating the electromotive force generated by a Gramme armature at different portions of the revolutions. F F' are the field magnets, B the positive and B' the negative brush; A is the armature. The length of the ordinates above the line L L' represent the relative heights of positive E. M. F., while the lower lines indicate the corresponding rise and fall of negative potential. Here, as in Fig. 1, we would naturally suppose the highest E. M. F. would be generated while the armature A was passing the point of maximum induction under the field magnets F F', which are about 90 degrees from the brushes B B'. This theoretical curve is shown by the dotted curve in Fig. 2. In practice, however, the point of highest potential does not correspond to the positions F F', but is moved forward to the point M I of maximum induction, in consequence of the armature reactions. As in Fig. 1, where the irregularity of the two quadrants in each half of the stroke depends upon the relative lengths of the crank and connecting rod, so, in Fig. 2, the angle of commutation and the point of maximum induction depend upon the relative strengths of the internal and external fields; or, in other words, it is dependent upon the relative intensities of the armature field and field proper. If the pulley or shaft of an engine had no momentum or inertia the motion imparted to it by a single crank would be very irregular, being most rapid while passing the "centres," where its effective force is nil, and becoming less rapid as the crank approaches the "quarter," where its power is greatest. Here we recognize the fulfillment of the old law of mechanics: "What is gained in power is lost in time, and *vice versa*." The irregular motion is rendered uniform by employing more than one crank, or by other methods. In dynamos the E. M. F. generated in a single armature coil is very irregular, as shown in Fig. 3, but is rendered steady and uniform by the use of more than one coil, as many as 160 having been employed in a single dynamo.

In a double engine with crank at 90 degrees, while one crank is on the centre and capable of exerting no effect, the other crank has the entire load thrown upon it. It would be far better to employ three cranks and thus equalize the work upon each. The advantages of this arrangement have been fully recognized in the construction of the Brotherhood three-cylinder engine. The same idea has also received an admirable application in the Thomson-Houston armature, which, as is well known, has three coils at angles of 120 degrees, so that while one is in the "neutral field," and is cut out of the circuit by the brush, the E. M. F. required to maintain the lamps is divided between the two remaining coils instead of being thrown upon a single one. The current is thus steady and uniform.

There are many ways in which the valve-gear of an engine may be driven; *i. e.*, from an eccentric upon the main shaft, the usual method; from a revolving shaft driven by gearing from the main; from the cross-head of the engine, as used upon the locomotives of the Boston, Revere Beach & Lynn Railroad, and from a separate engine, although this latter method would be far from practical. It would be necessary in this case for the two engines to be running at absolutely the same speed. For, suppose one were to lag behind or gain slightly upon the other, we have the following condition of things: The engine is running at a high speed and the piston is rapidly moving toward that very end of the cylinder in which steam is entering under full boiler pressure; the piston being backed by the momentum of the fly-wheel acts for the moment as a force pump, driving back the incoming steam, lifting the valve from its seat and subjecting the cylinder to an enormous pressure, which would probably result in the blowing out of the cylinder-head, or other damage to the engine. Such an accident frequently occurs when locomotives are suddenly reversed while running, and would also result from the slipping of the eccentric upon the shaft, and is quite common upon railroads.

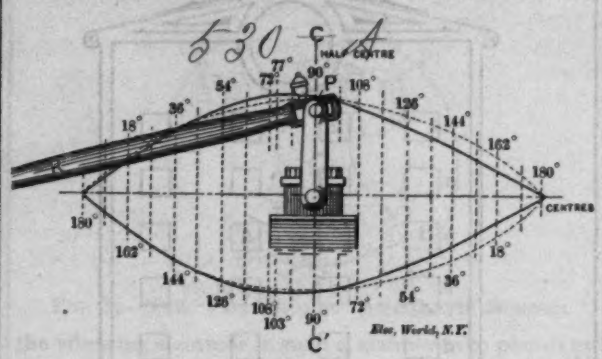


FIG. 1.

A condition of things closely resembling those just mentioned exists, unless special care is exercised, when two alternate current machines are coupled in single circuit. Here, as in the case of the two engines above, the machines (duplicates) must be running at absolutely the same speed, and so long as the alternations of the respective generators occur in exact synchronism, they will behave as a single machine; but if one were to gain even slightly upon the other, the alternations will no longer synchronize and the weaker machine will instantly stop, with probable damage to the dynamo, as did also the engine whose valve-gear was separately driven.

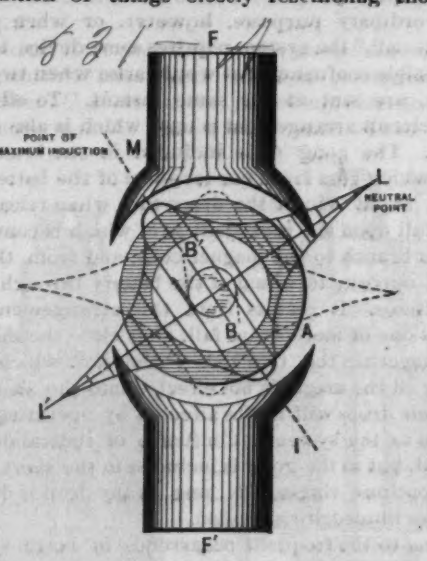


FIG. 2.

The field magnets of a dynamo are excited in various ways—by the whole current when in series; by a portion the whole current when in shunt; by a combination of series and shunt; by a combination of series and shunt or compound; or they may derive their field magnetism from a separate machine, separately excited, the latter being far more practical than the separately-driven valve-gear. A number of engines of different sizes and running at different speeds may be connected to a single line of shafting, and if the correct proportions exist between the diameters of the driving and receiving pulleys, so that each separate engine will independently drive the shaft at precisely the same speed, they will all work smoothly and without shock or strain, and by means of a clutch each engine may be started and stopped without difficulty, the only precaution being that when an extra engine is needed to first run it at full speed and then connect it with the shaft by a suitable clutch or coupling. The first engine may then be disconnected from the shaft by a similar clutch and stopped, the power having been transferred from the first engine to the second.

In like manner a number of shunt machines of different capacities and running at different speeds may be used to supply energy to a single circuit; and if each machine is driven at its proper speed, so as to generate the E. M. F. that is desired to exist between the mains, they will work well and each machine may be started or stopped independently of the others, the necessary precaution being, as it was with the engines, when an extra dynamo is needed, to first run it at full speed and turn on its field. It may then be connected or disconnected from the main circuit at pleasure, or the energy transferred from one dynamo to another.

It is not infrequently necessary to change a circuit of arc lamps from one machine to another. This is known in electric light stations as "changing over" and requires to be accomplished without extinguishing the lights even for an instant. Arc machines are also connected in single circuit, they being in series, while shunt machines are arranged in multiple arc or parallel. Generally not over three dynamos are thus connected, the positive post of one with the negative of the other, so that the current generated passes through the three dynamos in succession. Three cylinders of an engine are often *connected in series;* that is, the exhaust of the first engine being connected with the supply pipe of the second, and so on, the steam of course passing through the three cylinders. Thus arranged, it constitutes a triple-expansion compound engine.

A Formula Giving the Size of Wires for Incandescent Lighting.

BY C. S. BOWIE.

Having often noticed long discussions in regard to the size of wires to carry a given current, which include somewhat complex formulæ, I would suggest the following as a practical and simple rule that any workman can remember and use:

Divide the loss in volts by the number of ampères multiplied by the length of both wires in feet; the result will be the resistance of the wire per foot. Whence the gauge number may be found from this result in any wire table.

Expressed as a formula, in which V is the loss in volts, C the current in ampères and D the length of wire, it becomes $\frac{V}{C \times D}$ = resistance per foot.

The following problem in incandescent wiring shows how to use the formula: A feeder 800 feet long, that is, requiring 1,600 feet of wire, is required to carry 80 ampères, with a loss of 15 volts in pressure. What gauge number must be used, using the above formula?

$$\frac{V}{C \times D} = \frac{15}{80 \times 1600} = .0001171+,$$

which is the resistance per foot of the wire, and corresponds to No. 1 B. W. G. nearly. This formula follows directly from Ohm's law, $\frac{V}{C}$ being the total resistance, and dividing by the total length in feet gives the resistance per foot.

Mains and service wires may be calculated similarly to the above. This formula is easily remembered, and can be used and understood by any ordinary workman.

Radiation from Dull and Bright Surfaces.

Mr. J. T. Bottomley, F. R. S. E., calculating from certain results obtained by Mr. Mortimer Evans in experiments on the light-giving power of carbon filaments with bright and dull surfaces, arrives at the conclusion that the temperature to which the carbon filament must be raised in order that it may give out light of a definite candle-power, is higher in the case of a dull-looking filament than in that of a bright one. Mr. Bottomley has tested this conclusion by experiments on similar platinum wires, one blacked, the other left in its bright condition. These wires were soldered into tubes exhausted by the Sprengel pump to about $\frac{1}{1000000}$th of an atmosphere. A current from six accumulator cells was sent through them, properly regulated by a variable resistance of platinoid wire and a rheostat. The experiments showed that the deduction he had made from the figures of Mr. Evans was borne out. For instance, when the wires were both at a dull heat (estimated temperature 600 degrees for the bright wire), the ratio of the resistance of the lamp-blacked wire to the bright wire was 130 to 98. Platinum wires differ very much as to variation of resistance with temperature; but in most specimens, according to Mr. Bottomley, the resistance is doubled when the temperature is raised from 0 degrees Cent. to from 300 degrees or 400 degrees Cent.; and for any particular platinum wire the change in resistance is almost in simple proportion to the temperature. From this it may be judged that the difference of temperatures between the two platinums, dark and bright, when giving out the same light, was a great many degrees Centigrade. The difference of temperatures of the two glass envelopes was also very

marked; that containing the bright wire being not even unpleasantly warm; whereas that containing the dull wire was so hot as to blister the skin.

Patten's Electric Annunciator System.

When arranged to give indications from a large number of distant points annunciators involve a somewhat complex system of wiring, and the instrument placed at the central office is frequently large and occupies space valuable for other purposes. This is also the case in systems arranged for signaling a variety of wants from the different rooms of a large hotel to the central office, indicating at the same time the particular room at which an article is required; hence many attempts have been made to contrive combination systems having in view a reduction of the number of wires used as well as the parts of the receiving apparatus, and thus to diminish the cost of both. The system in common use necessitates as many indicators or drops and as many magnets as there are points from which indications are required, each drop or number being connected through its magnet to a separate complete wire circuit independent of all the others from the annunciator to the distant room and back.

To avoid this, Lieut. F. J. Patten, U. S. A., has designed a system which consists in the application of a new principle to the construction of call systems, by the use of which a given number of signals may be obtained from a similar number of distant points with a comparatively limited wire system, and less than one-half the number of magnets and drops formerly used.

This is accomplished by using the number of possible combinations that can be formed with a given number of elements; the only condition imposed being that no two of the combinations used shall be alike. The elements combined are the indicators or drops in the annunciator, as well as their corresponding wire circuits, the circuits being operated by a multiple key or contact worked by a single push. The different signals are shown by a corresponding combination of one, two, three or more drops, each bearing a single figure, and, falling simultaneously, are read in the usual way from left to right, thus giving the number or indication required.

The following analysis shows how the principle finds its application. Viewed simply as elements, the figures 1, 2, 3 and 4 are susceptible, when taken in combinations—first each alone, then two and two, then in groups of three and so on—of just fifteen combinations, no two of which are alike. They are as follows:

1	2	3	4		
12	13	14	23	24	34
123	124	134	234		
1234					

This gives a total of 15. These are all the possible unlike combinations that can be made of four single elements. Evidently, however, if one more element, such as the figure 5, be added, fifteen new combinations can be made by adding the figure 5 to each of the combinations, thus always doubling the number of possible combinations by

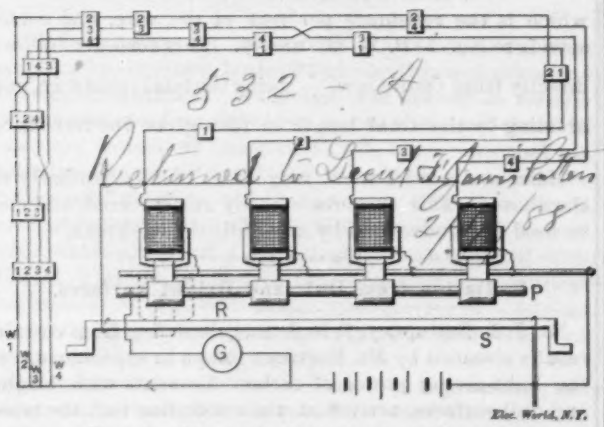


FIG. 1.—PATTEN'S ANNUNCIATOR SYSTEM.

adding a single new element to the original number or set. The principle is thus shown susceptible of very rapid extension to any desired limit, for while 4 elements give 15 unlike combinations, 5 elements give 31, 6 elements give 63, and so on, 10 elements giving 1023.

Using only four elements or numbers, 15 different points or rooms may be designated by the numbers obtained by their combination. But in precisely the same way four simple wire circuits may be combined as distinct elements, each circuit controlling a separate drop or indicator, and so give 15 different indications or signals with four drops, four magnets and four wire circuits only. This is accomplished in the following manner:

The different rooms or points of the entire system are numbered by the 15 combinations given above, 1, 2, 3, 4, 12, 23, 34, etc., these being shown by the little squares in the diagram, Fig. 1, which indicates the arrangement of the combination circuit system for fifteen indications. The four lines represent four contiguous parallel wire circuits, each circuit controlling its own separate magnet and drop numbered respectively 1, 2, 3 and 4. All these circuits go together from the annunciator successively through all the points from which indications are required, and all together return to the annunciator, thus completing the circuit system.

The four circuit wires W_1, W_2, W_3 and W_4 go through the different points, at each of which a key is arranged to operate a different combination of the four circuits. Thus, starting from the left, the first point or room is designated 1234, and here the key is so arranged that when the button is pushed it actuates all four magnets simultaneously and all four drops fall, displaying the figures 1234 in a row as a single number.

At the next point the push is arranged to operate three circuits only, one circuit remaining unaffected. Three magnets are thus actuated and three drops fall, displaying one of the numbers containing three figures, as 123. At the next point another circuit is omitted, and at the

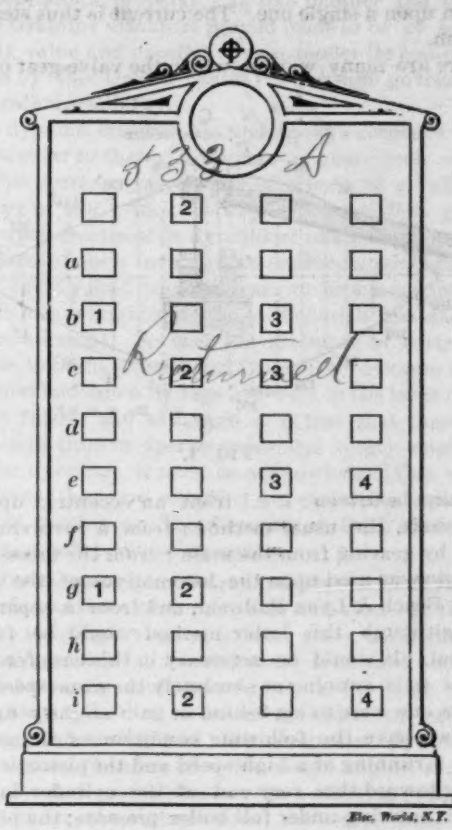


FIG. 2.—PATTEN'S ANNUNCIATOR SYSTEM.

next another, and so on. The circuits are then omitted in sets of two at a time, of which there are six combinations; then they are left out in sets of three at a time, when the wires operate the drops 1, 2, 3 and 4 singly.

In the particular case where no two calls are likely to be sent at the same instant nothing further is required to complete the system, and even in this form it has a variety of applications.

For ordinary purposes, however, or when used as a "wants-call," the system requires some device to prevent the possible confusion that would arise when two or more signals, are sent at the same instant. To effect this, a shunt circuit arrangement is used which is also shown in Fig. 1. The gong G is included in one branch of this shunt which goes from one terminal of the battery to the rod P, about which the drops turn when released. The latter fall upon the rock shaft $R\,S$, which is connected by another branch to the magnet coils, and from them back to the opposite terminal of the battery through the usual connections. It results from this arrangement that as soon as one or more drops fall, they close the short circuit by connecting the two rods P and $R\,S$, which instantly throws all the magnets not effected into the short circuit, and their drops will not be affected by operating any key or push in the system. Confusion of indications is thus avoided, but as the gong is included in the short circuit it will continue ringing as long as any drop is down, thus insuring immediate attention.

Owing to the frequent occurrence in large systems of the sending of a number of absolutely simultaneous calls, it becomes necessary, for a large number of indications, to use a number of such sets of four or five-wire circuits, each set controlling a separate independent row of drops. This method of applying the system is shown in Fig. 2, which may represent an annunciator for 150 rooms. It has five rows of five drops each, making 25 in all. Each row is operated by a five-wire circuit system, each of which, as before explained, gives 30 indications. Thus, each row is adapted to one set of 30 rooms, all being grouped in sets either by floors or arbitrarily, the first set being known as 1, 2, 24, 34, etc.: the second as 1*a*, 2*a*, 24*a*, 34*a*, etc.; the third, 1*b*, 2*b*, 24*b*, 34*b*, etc.

At $2 a figure the ordinary 150-drop annunciator costs $300; on the combination system 25 magnets and drops only are required, reducing the nominal cost of the instrument to $50, hence the possible reduction of expense is very evident. The same 150 rooms could be arranged on ten four-wire circuits, each giving fifteen indications and admitting of ten possible simultaneous indications. Thus arranged, 40 magnets would be required instead of 150, and, according to the inventor, annunciators can be made on the system indicated for about one-half their present cost and leave a wider margin for profit than before.

It is evident that the system can also be used as a simple form of "wants-call," either in connection with an annunciator arranged in the usual way or otherwise. In the former case, it is only necessary to add a single row of four drops and run a four-wire cable through the rooms in series. In each room ten keys, or more, can be arranged as a multiple push, as shown in Fig. 3. In this the central button is the room-call connected in the usual way, the pushes surrounding it operating the "wants-call," the designation of each push being stamped upon it and its corresponding number being known at the office.

Such a system requires no special mechanism for transmission, and affords a very cheap and simple system by means of which a series of calls to the number of fifteen or more, if necessary, can be added to any ordinary annunciator system. This requires only an additional four-wire cable, the same number of drops in the annunciator and a multiple push button placed in each room.

The National Electric Light Association and Patent Legislation.

The executive committee of the National Electric Light Association, of which Mr. S. A. Duncan is chairman, has issued the following circular letter, which reached us too late for insertion in our last issue:

"The secretary of the association reports to the executive committee that the stenographic report of the proceedings and the papers read at the conventions held in Detroit, Philadelphia and Boston, and which constitute most valuable chapters in the history of application of electricity to the demands of modern civilization, are still unprinted. The lowest bid that has been received from the printers is about $1,000 for 1,000 copies of about 800 pages.

"The treasurer reports that the funds in his hands are entirely insufficient to meet this expense.

"The Committee on Patent Legislation reported to the convention held in Boston, Aug. 9, a bill (of which a copy is inclosed) to be presented to Congress, providing for a revision of the patent laws of the United States, and particularly for certain changes and reforms in the Patent Office, the necessity for which has forced itself upon the members of the association. The bill provides for the creation by Congress of a commission to revise the present patent law, and correct the existing defects. To insure the passage of this bill much labor will devolve upon the committee, as well as some expense for clerical work, printing, postage, etc. About $1,500 will be needed to properly present the bill before Congress.

"The passage of this bill is the most important work that has been undertaken by the association since its organization, and the committee feel confident in calling upon the members of the association for its assistance. The committee have thought it better to raise the funds necessary for these expenses (about $2,500) by the voluntary subscription of the members, rather than by an

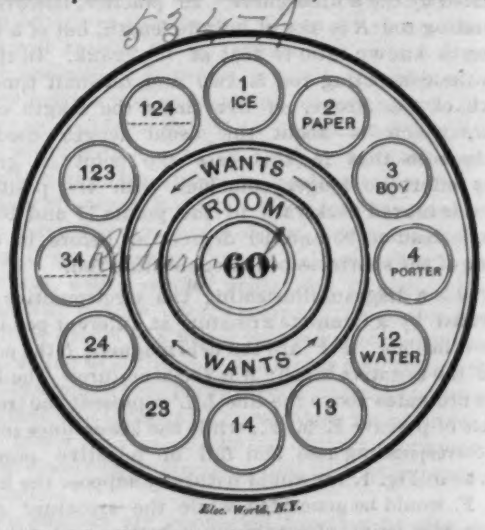


FIG. 3.—PATTEN'S ANNUNCIATOR SYSTEM.

assessment, but they feel that so great is the importance of preserving the records of the association, and so vital to the interests of all those engaged in electric lighting, is reform in the patent laws, that ample funds can be raised in this way.

"They ask that you will fill up the inclosed blank for such an amount as you are willing to subscribe, and return it to the treasurer. The money is needed at once, so that prompt action upon this matter is especially requested."

Recent Improvements in Ocean Telegraphy.

A joint meeting of the New York Electrical Society, the Electrical Section of the American Institute, and the American Institute of Electrical Engineers will be held on the evening of Wednesday, Nov. 9, in the Manager's Room, at the American Institute Exhibition Building, Third avenue and Sixty-third street, this city. Mr. Chas. Cuttriss, electrician of the Commercial Cable Company, will read a paper entitled "Recent Improvements in Ocean Telegraphy," and the members will be afforded an opportunity of inspecting the Cuttriss cable recorder at work in the exhibition, besides the other exhibits.

The New "Bartholdi" Automatic Burner.

One of the principal obstacles met with in the working of automatic gas lighters has been the difficulty of making a valve, which at the same time would require a minimum of power to operate it to turn the gas on and off, and still be thoroughly gas-tight and free from any danger of becoming accidentally turned on. The valve which has been generally employed for this purpose has been constructed like the ordinary gas-cock in use on gas fixtures, and consisting of a conical plug rotating within a barrel. In order to make such a cock gas-tight the surfaces must be ground together so as to insure a close fit, and then must be held in contact by some form of spring to prevent separation. The amount of power developed in the magnets of the burner is but small, owing to the necessarily small size of the helices employed. As a consequence, when the surfaces of the plug and barrel are sufficiently forced into contact to insure of no leak the friction is so great that the magnet is incapable of operating the cock, and *vice versa*, when the friction is diminished the cock is apt to leak. Again, a gummy deposit is sure to be formed from the gas, which increases the friction of the moving parts.

It was to avoid these difficulties that Mr. A. L. Bogart, of this city, brought out the "Bartholdi" automatic burner, the latest form of which possesses a marked degree of originality, and which, it is claimed, removes all the objections raised against automatic burners.

In the new "Bartholdi" burner no rotating stop cock is employed, the gas being controlled by a form of puppet-valve, which is simply raised from its seat in order to open the gas-way; and as it is operated from within the gas-way itself, there is no necessity of any packing to prevent a leak about the valve-stem. As the surfaces are not in contact when the valve is being operated the friction is reduced to a minimum, the entire energy of the magnet being employed to simply lift the weight of the armature and valve spindle a distance of a fraction less than one-sixteenth of an inch in opening the gas-way. Again, as the valve is held normally closed in its seat by the weight of the operating armature, to which it is rigidly attached by means of a connecting stem, should it by any accident be lifted, it will immediately reseat itself by its own gravity and close the passage.

The engraving, Fig. 1, shows a perspective view of the new burner, full size. Fig. 2 is a part sectional view, illustrating the operating mechanism, and Fig. 3 is a view from below, showing the armature which operates the valve.

As will be seen, the burner consists of three parts. One of these, the tip-socket *A*, Fig. 2, contains the lava-tip and spark-producing electrode. This is provided interiorly at the bottom with a screw-thread *b*, by which it is secured to the second part, consisting of the flange *B B*, to which is attached the valve, valve-seat, magnets and operating mechanism. The third part consists of the metal shell *D D*, inclosing the working parts of the burner and provided at the bottom with a screw-thread *E* for attachment to the gas-pipe. The valve-seat *F* is of brass, forming a part of the flange *B B*, and consists merely of a hole drilled through the same, about one-eighth inch in diameter. Upon this rests the conical valve *G*. Attached to the valve is a spindle *H*, to the lower end of which is secured a wrought-iron armature *J*. Thus it is the weight of the armature which acts to keep the valve in its valve-seat.

Below the flange *B B* and as a part of it, is a wrought-iron disc *K K*, having a screw-thread around its periphery, the disc serving as a means of attaching the metal shell *DD*, and also as the yoke for the electro-magnets. From this disc proceed four magnet cores each wound with a wire helix. The relative positions of the four cores is shown in Fig. 3, *M*, *M'*, *P*, *P'*. Those diagonally opposite one another are connected together, as shown in the figure; thus *M* and *M'* constitute one horseshoe electro-magnet, and *P* and *P'* the other. In Fig. 2 only one helix of each pair is shown.

The four cores are held in position by a brass plate *R R*, which also serves as a guide for the valve-spindle *H* which passes through it.

The armature *J J* has the form shown in Figs. 2 and 3. One side of it is cut away, and through the slot *c d* extends a hook shaped rod *e*, which is rigidly attached to the metal plate *R R*. To the right of this slot in the armature is a recess or cavity *d*, situated in the bottom edge. If now the valve be in its normal position, as shown in Fig. 2, then the armature occupies a position so that it covers the poles *P P'* of one set of magnets, and exposes those *M M'* of the other. If now the helix *M* and its companion *M'* be energized by passing a current through them, the tendency of the two is to elevate the armature, and when the lower edge of *d* has passed the upper end of the hook *e*, then to twist the armature to the left so as to bring it into such position as to cover the poles of the spools *M* and *M'*. The armature will thus be brought into the position of the dotted lines. This same action will have caused the valve to have been raised away from the valve seat to the dotted lines shown. In this position the recess or cavity *d* will now stand at *d'* immediately over the hook *e*, so that if the circuit be broken the armature will fall, the recess *d* engaging the hook and locking the armature so as to hold the valve still open. To shut the gas-way the helix *P* and its companion *P'* are now energized, when the armature will be raised again and twisted to the right so as to cover the poles of magnets *P* and *P'*, which were uncovered by the preceding action. If then the circuit be broken the armature will fall to its original position and the valve be closed.

The method of producing the spark for igniting the gas is the following: The insulated fixed electrode *S T* terminates in a horizontal platinum wire point at *T*. The movable vibrating electrode *U V* has a rigid prolongation *W*, which extends through the side of the tip-socket at *V*; at this point the prolongation of *U V* is hemispherical in shape and fits into a conically shaped recess in the tip-socket wall, thus forming a valve and valve-seat which is ground gas-tight. The upper end *U* of the vibrating electrode is furnished with a platinum wire point, which rests in contact with the wire point in the fixed electrode *T*. A metal guide *h* screwed to the tip-socket surrounds

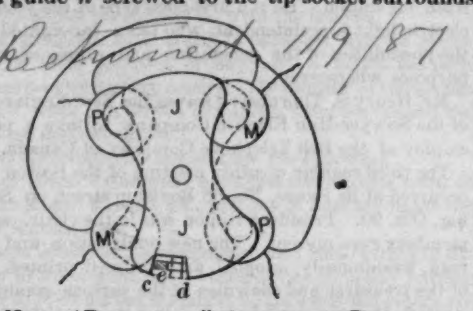
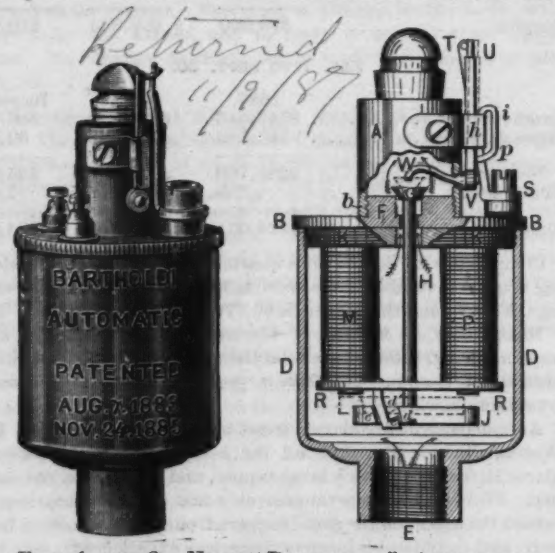


FIG. 3.—NEW "BARTHOLDI" AUTOMATIC BURNER.

the vibrating electrode in such a manner as to permit motion only in the plane of the paper. The guide being of spring brass has a portion *i* bent over the lower end resting against the vibrating electrode at *p*, and acting as a spring having two functions. One of these is to hold the two contact points *U T* together, and the other, to keep the valve *V* firmly upon its seat and gas tight. The circuit passes first to helix *M*, then to its companion *M'*; from thence to the insulated fixed electrode *S*, through its contact point *T*, to that of the vibrating electrode *U* and so to the body of the burner, the gas pipe and back to the battery. Should this circuit be closed the armature will be attracted and twisted to the left as already described; at the same time the valve is raised so as to encounter the end of the prolongation *W*, raising the latter to the dotted line at *W*. This causes a separation of the contact points *U* and *T*, the former being moved away in the direction of the dotted line. The circuit being thus broken, the armature falls a slight distance, but not enough to shut off the gas, so that when the circuit is again closed by the points *U T* coming in contact, the same action is repeated, causing a continuous vibration of the electrode *U V*, and a succession of sparks are produced as long as the finger of the operator is kept on the circuit-closing key. When the key is opened, the armature falls into its lock, leaving the gas ignited and burning.

The circuit for extinguishing the gas passes to *P*, then its companion *P'*, and then, instead of passing to the circuit-breaker *U T*, as in the preceding case, it goes directly to the metallic case of the burner. Thus, in turning off the gas no spark or successive vibration of the circuit breaking electrode is produced.



FIGS. 1 AND 2.—NEW "BARTHOLDI" AUTOMATIC BURNER.

It will be seen that owing to the extremely short distance through which the armature has to move to open the gas way, no deposit in the gas valve seat can effect a sticking of the valve, as, owing to the the proximity of the armature to the poles of the magnet, the power to move it is considerable; and further, the surfaces in contact at the valve are very small, as the edge of the valve seat is of extremely small circumference and consists of a sharp edge.

As the tip socket can be readily removed at any time by unscrewing it, it permits of ready access to the valve and valve seat for examination and cleaning should such be required.

It will be noticed that there is no spring contained within the burner, nor is there any part that requires adjustment after the burner has once been put together, excepting that of the contact points, should they receive a blow or fall.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Oct. 31 1887.

The Stratton Separator Company have removed from No. 38 to No. 32 Cortlandt street.

At a recent meeting of the Board of Trustees of the Excelsior Electric Company, the following officers were elected for the ensuing year: William Keuffel, president; H. H. Bowman, treasurer; George D. Allen, secretary. Mr. Allen was also reappointed general manager of the company, a position he has long and ably filled.

I was in the office of the Roberts-Brevoort Manufacturing Company, at 206 Broadway, recently, and witnessed the lighting of five 16 c. p. incandescent lamps, taking 1⅛ ampère, from 14 cells of battery. The latter is the latest invention of Mr. I. L. Roberts, and I think it quite probable that we shall hear more of this battery in the near future. The cells employed measure 15 x 7⅛ inches, and stand 15 inches high. Each one contains a zinc and four carbons, capable of delivering 30 ampères at an E.M.F. of 2 volts. I am informed that these 14 cells have run the 5 lamps for 250 hours, thus giving the battery a capacity of over 1,200 lamp hours. Mr. C. W. Madden, manager of the Empire City Electric Company's retail store at 779 Broadway, has used three of these cells 10 hours every day for two months, to run toy motors, window-tappers, moving figures, and also a ⅛ h. p. C. & C. motor, driving a sewing machine. I saw the zincs of these batteries and could detect no sign of local action. Mr. Madden is surprised at the results obtained, but insists upon their accuracy.

Mr. T. McCoubray, Jr., representing the Baxter Electric Motor and Manufacturing Company, has opened a branch office at Room 501, No. 146 Broadway. Mr. McCoubray, at one time secretary of the National Electric Light Association, has a very wide acquaintance in electrical circles, and will undoubtedly find himself at home and highly successful in New York.

Ostrander & Peck, 21-23 Ann street, have been manufacturing oral annunciators and bells in their big Brooklyn factories, for a number of years, and have a marked predominance in this department. I have met buyers from all parts of the country in their office, and know that the goods are as plentifully distributed West as East. Some few years ago the firm foresaw the advantage of adding electrical supplies to their already large trade, and have now built up an extensive electrical supply business. In the various lines they are continually bringing out novelties, and their catalogue is quite a voluminous publication. They have just brought out a new iron frame bell, and I may note here that all their bells have platinum points. The assortment of push buttons, electric door openers, etc., is endless, and the same excellence of finish is maintained throughout.

Messrs. Hughes & Browning, New York State agents for the Edison system are actively engaged on new orders. Among the contracts lately sent in by them is one for two dynamos from the Cooperstown Electric Light and Power Company, of 450 lights each; another of two machines of 600 lights each, for the Union Depot, Troy. Mr. Hughes has his office at 87 Shonnard street, Syracuse, and Mr. Browning at 40 Tweddle Building, Albany.

Williams & Potter, Fourteenth street and Fifth avenue, contractors for Edison steam plants, are completing some out of town and foreign installations. They have a great penchant for the Straight Line engine. They put in two recently for the new Turkish Baths, Twenty seventh street near Broadway. Two more go into the Broadway Theatre for the 1,100 light Edison plant, the order for which was secured by Mr. McLean. Messrs. Williams & Potter are exhibiting two Edison dynamos at the Electrical Exhibition, with Straight Line and Armington & Sims engines, and supplying power for the Sprague motors.

Hadley, Bennett & Co., 48, 50 and 52 Church street, are in the business of electric light contractors, undertaking to put in arc and incandescent plants of any system, in conformity with the requirements of the New York fire rules. They do wiring of every description, and are prepared to take orders for all manner of electrical work.

The long distance telephone system continues to attract the attention of the city papers. This is what might be expected, for the changes that the system are likely to introduce in commercial and financial affairs are most important. Speaking of the extension of the system the *Times* says:

"The Boston circuit will be opened in three weeks with 30 wires and the communication will be as direct as it is now between this city and Philadelphia. It is expected that the service to Albany will be opened on Jan. 1. One hundred pole raisers began work in August at Albany and they reached Hudson last week. At the same time another force went to work at this end and are at Poughkeepsie. The river road of the West Shore is followed. The poles are from 45 to 50 feet high and so strong that from 50 to 70 wires can be strung with safety. The wire stringers will be put to work this week. Twelve copper wires will be placed at first, and the cost of the wire is estimated at $90,000. The entire cost of connecting New York and Albany is estimated at $300,000. The Hudson River here and at Albany will be crossed by cables. When the circuit is established between the two cities the lines will be extended through the State to Buffalo, to Cleveland, to Cincinnati and to Chicago. So perfect is the system that talk can be carried on as easily between points 500 miles apart as 100 miles. Time and distance are the basis of charges for the use of the long-distance telephone. It is becoming popular for several firms to combine and rent a wire between distant points. If there are three firms in the combination they mutually arrange a schedule, each firm agreeing not to take more than twenty minutes an hour. Single wires from here to Philadelphia, to be used between 4 P. M. and 2 A. M., are rented for $100 a month. This includes two outfits and repairs. There are repair stations every forty miles along the lines. The Boston wires will be worth $200 a month and those to Albany less. Those who have watched the development of the telephone are enthusiastic over the possibilities of the long-distance system, and say it is destined to work a revolution in professional and commercial circles. There is a story told of a recent achievement with the invention by a certain railroad. The company got up a new time-table which was put in type 200 miles from the executive office here. The proof was read and corrected by copy over

the telephone wire with almost as much facility as if the company's representative had been in the printer's office."

The general use of arc lights for city purposes in Brooklyn, and the inevitable extension of the system in the new and growing quarters, renders necessary some change in the manner of indicating the names of the streets. The gas lamps that once served in this way are dark and dismantled and are worse than useless. Mr. Murtha, of the City Works Department, says: "We have not yet decided on a plan, but will either select a new patent sign that has been submitted or place a cross sign on the electric light poles at an elevation that will render it a ready means of ascertaining by day or night the street thus designated. We shall have to wait until the elevated railway structures are finished, however, before taking any action on the thoroughfares where they are building, as the electric light companies will have to change their system of illumination. They intend introducing arc lights, which will be placed lower than the elevated railway structures, thus throwing the full force of the light on the streets. The street signs will be placed immediately beneath these lights. On thoroughfares where no elevated roads are to be run we shall take action without delay. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Oct. 31, 1887.

The general activity in electrical circles that has been so noticeable here during the summer has become accentuated by the approach of winter, when the demand for electric light and power is heavier than at any other season. Nothing could more impress this fact of activity on the mind of an observer than a visit to the Thomson-Houston factory at Lynn. There was a time, not so long ago, when the company did not need all the space within the walls of the large building, and it is said that some of the younger members of the staff were accustomed to take bicycle practice on the upper floors. That is but a year or two since, yet so great has been the persistence, energy and ability displayed in running the business that the factory is to-day filled to overflowing with machinery and work in hand, from cellar to roof. Not a single clear passage way can be found in any of the departments. The floors are jammed with work in all stages of progress, and the employés are crowded together to such an extent that one wonders how another dozen could possibly be squeezed in. Although a large quantity of experimental work, conducted by Professor Thomson and his assistants, Messrs. Rice, Rohrer, Curtiss, Randall and others, is always in hand, it is carried on in a space that is necessarily limited, and the whole establishment rattles and roars with the bustle of ceaseless output, for the work goes on night and day. A visit last Thursday night, when the hands were being paid off, suggested that the whole town of Lynn was in line, so endless seemed the procession. Out of this state of affairs has grown the imperative desire for more room, and a splendid addition is now nearing completion. Some idea of the growth of the business is afforded in the intention to give up the annex to the motor and the alternating business, and by the installation there of a 500 h. p. Greene engine. Hither a few of the 800 employés will be shifted, serving as the leaven for the new force, just as veterans do in freshly recruited regiments. Even here the development does not end, for just beyond the annex is a third building of no mean dimensions, to be devoted exclusively to the Thomson welding process, the field and outlook for which are already assuming gigantic proportions. Altogether the growth of such an industry, in one branch of electrical application, the supply of light and power, is most impressive, and one feels in contemplating it that finality of extension and limitation of output are the things that are least possible and last to be expected. The momentum acquired by a business of this character is something tremendous, and yet it has taken only two or three years to write thus the first pages of one of the most interesting chapters in the record of New England enterprise and invention.

As the prompt notice given by electricity of the recent fire in the Parker House continues to attract attention and excite comment in these regions, when the public eye is ever fixed on Boston, I may here venture to supply an omission in my previous narration of the event. On the principle that his is the palm who merits it, the system entitled to publicity in this connection is that of the Boston Auxiliary Fire Alarm Company, operating under the Rogers patent. The parent company, having its headquarters at Providence, is the Alarm Box Comptroller Company. If I am not mistaken, this is the only system of the kind allowed connection with the fire-alarm service of the city of Boston, and it must be evident to all who remarked the occurrence that the alarm sent out on this occasion was singularly timely and valuable, showing how goodly a device it is that furnishes the citizen with a fire alarm as handy as a push button in his store, at his desk, or even at the head of his bed.

Francis J. Hovey, of the American Telephone & Telegraph Company, which operates the long-distance line just brought through Springfield, and A. J. Lewis, superintendent of the Boston office, are arranging for the new telephone service. Four gangs of men are working on the line between Springfield and Boston, but it will take two months to finish it. A loop will soon be built into Hartford. Already the lines between New Haven, New York and Philadelphia are well patronized. Three firms at Ansonia, Conn., have leased a wire to New York, seventy miles away, and each has the use of it for twenty minutes every hour to talk with their New York houses. Similar arrangements have been made with manufacturers at Meriden, New Britain and Danbury. Lines are to be built to various other cities, and on a temporary wire from New York to Chicago, Mr. Hovey recently talked with ease, although his listener was 1100 miles away.

Springfield, in this State, will very soon have its Westinghouse alternating system in operation, with about a mile of underground wires already laid, and over 2,000 lamps, I believe, ordered in. These lights will be run from Mr. Hyde's station, in addition to the large Thomson-Houston system. The incandescent machine, heretofore running the direct service, will be devoted to motors, for which there is a great demand; and all the incandescents will be run on the alternating system. Mr. Alex. Wright has had charge of the new work for the Westinghouse Company and has done it in that peculiarly neat, clean-cut and thorough manner which everybody who knows him associates with his installations. Mr. Wright has a positive genius for installation work, so that while no engineering detail is neglected there is a characteristic air of finish and refinement, even of beauty, about the whole.

Woonsocket, where the new electric railroad is in operation, is becoming the Mecca of a new pilgrimage on the part of street railway men from all parts of New England. Any one who has traveled on the car up that 7 per cent. grade as it curves beyond the bridge, and has seen the ease of the performance, even when the car is carrying 40 and 50 passengers, will not be surprised to learn that the example set is proving contagious, so to speak, and that a large number of New England towns will soon be patterning after hilly Woonsocket, especially where the water power is as available as that of the winding Blackstone. Mr. F. S. Pond, of the Woonsocket Electric Machine and Power Company, is watching the road with great interest, as the current is sent out from his station. He is a first-class type of the young progressive electric light superintendent, who has a far-sighted realization of the possibilities of the generation and supply of current for all purposes whatsoever.

Mr. Henry S. Thornberry leaves the New England department of the Sawyer-Man Electric Company to take a position in the employ of the Bell Telephone Company of Canada.

The third regular monthly meeting of the Boston Electric Club occurred at its rooms, No. 66 Boylston street, on Saturday evening, Oct. 29. President Ridlon was in the chair, and fully sixty members were present. The new constitution and by-laws were read, unanimously adopted, and ordered printed. The reports of the treasurer and chairmen of the various committees demonstrated that the organization is in a very satisfactory condition, financially and otherwise.

At the meeting of the Society of Arts at the Massachusetts Institute of Technology, on Thursday evening, Oct. 27, Mr. N. M. Lowe exhibited and described electrical apparatus for the accurate measurement of water.

The Sawyer-Man Electric Company is installing a plant of 250 incandescent lights in the restaurant of Messrs. D. Cooke & Co., Avon street, Boston, and another isolated plant of 80 lamps (including an additional Thomson-Houston incandescent dynamo) in the new building of Messrs. P. H. Stearns & Company, Boston. This company has its men at work on other installations of its system as follows: 166 lights in the Park Central Hotel, Hartford, Conn., and 300 lights in the Eagle Mill of the American Screw Company, Providence, R. I.

On Thursday evening, Oct. 27, the Committee on Electric Lights at Hyde Park, Mass., held a meeting, and the form of the bond offered by the American company to which the contract had been previously awarded, was approved. A sub-committee of seven was appointed, with full power to pass upon the sureties. The selectmen were instructed to sign the final papers as soon as the company has done so, and the sub-committee has made a favorable report on the sureties. Another sub-committee was appointed on location of lights and height of poles. It was voted to allow the company until Dec. 30 to have the lights running.

On Wednesday, Oct. 26, the directors of the New England Telephone & Telegraph Company declared the usual quarterly dividend of 75 cents per share. The comparative statement for the quarter ended Sept. 30 is herewith given:

QUARTER ENDED SEPT. 30.

	1887.	1886.	Increase.
Gross receipts	$255,858	$232,585	$23,271
Gross expenses	174,737	162,773	11,963
Net earnings	$181,119	$69,811	$11,308
Construction	1,149	778	371
Surplus	$79,920	$69,033	$10,937

JAN. 1 TO SEPT. 30.

	1887.	1886.	Increase.
Gross receipts	$747,546	$681,374	$66,174
Gross expenses	518,786	488,469	30,317
Net earnings	$288,760	$192,903	$35,857
Construction	4,699	3,847	1,852
Surplus	$224,061	$100,050	$34,005

Compared with the previous quarter, ended June 30, the showing is quite favorable, gross receipts increasing $4,074; net earnings, $7,925, and the surplus is $6,776 larger.

Messrs. Kimball & Stow, of Fitchburg, Mass., electrical engineers and contractors, have established a branch office at No. 43 Milk street, Boston. This firm is prepared to do all classes of construction work.

An independent fire alarm circuit has been introduced in East Boston, Mass. Hereafter all the companies will receive every alarm in the district on a large tapper, and also on the old small one. Previous to this arrangement some of the companies received the alarm on the small tappers from about nineteen boxes only, and considerable inconvenience was experienced.

Mr. F. E. Pettingell and Mr. Geo. T. Armstrong have formed a partnership and established an eastern branch office, representing the Cleveland Motor Company, of New York (formerly of Cleveland, Ohio), the Okonite Company, of New York, and the Forest City Electrical Works, of Cleveland, Ohio. The offices of this firm are at No. 95 Milk street, Boston.

A manufacturing enterprise, new to the electrical fraternity, but in all probability destined to become well known and popular far and near, within a very brief period, is the Adamanta Manufacturing Company, of Boston. This company manufactures solid rubber boxes and rubber lined boxes (acid proof), which are compact, durable, and reasonable in price. Manufacturers of accumulators and makers of various forms of primary batteries which contain solutions in which acid forms an important adjunct will be pleased to learn of the new enterprise referred to. The Adamanta Company is at present experimenting with its product, to ascertain the adaptability of the Adamanta rubber as an improved insulation for aerial and underground wires and submarine cables. This company's office is No. 25 Mason Building, Boston.

At a special meeting of the stockholders of the Wainwright Manufacturing Company, of Boston, held on Oct. 26, the following officers were elected: Jere Abbott, president; John A. Loring, vice-president; Percival L. Everett, treasurer; C. D. Wainwright, general manager; James M. Betton, secretary. Directors: Jere Abbott, John A. Loring, Percival L. Everett, Charles S. Dana, Gideon Scull, William B. Bacon, C. D. Wainwright. The company is said to have a long list of unfilled orders on hand.

A new watch has been invented, which the Waterbury Watch Company has just commenced to manufacture. It is a stem winder, and is said to be an improvement on the old Waterbury. The factory is at present turning out 200 per day of the new watches and 1,800 of the old ones.

Edward Davis, of Cambridge, Mass., has invented a police signal system, the merits of which were exhibited at 109 Court street recently. The main advantages claimed for this system is its simplicity of construction and the large number of different signals of which it is capable. It has, for the use of the officer, a number of pulls, each of which is recorded at the central office with the number of the box from which it is sent. These signals are for fire, ambulance, patrol wagon, etc., and a telephone can be used if desired. If keys should be furnished to citizens, any person who uses one and sends a call from any box will be known at once by the number registered at the office, both the box number and the citizen's number being registered; also the exact time the call is sent. W. I. B.

ST. ALBANS, Oct. 29, 1887.

The St. Albans (Vt.) Electric Light and Power Company have contracted with the Thomson-Houston Electric Company, of Boston, for the installation of an electric light plant of 70 2,000 c. p. arc light capacity. The installation, for street and commercial lighting, includes the building of a central station (nearly completed) 70 by 30, with brick boiler room, 30 by 24, a 100 h. p. steel boiler of the return tubular type, manufactured by the Phœnix Foundry and Machine Company, of Syracuse, N. Y.; a 90 h. p. Ball engine, built by the Ball Engine Company, of Erie, Pa., with pump, feed-water heater, injector, etc., of approved make.

The Thomson-Houston Electric Company are to furnish all material and do the work of putting in the street construction for 30 2,000 c. p. arc lights for the village and 10 arc lamps for the yard and train house of the Central Vermont Railroad Company. The street lamps are to be placed at the centre of intersecting streets by the use of the "Wing lamp hanging crane," at a possible height of 40 feet from the ground, with facilities for raising, lowering, cutting out, or holding the lamps at any desired altitude without climbing.

The halls, waiting rooms and principal offices of the Central Vermont Railroad Company are to be lighted with series incandescent lamps of 65 and 125 c. p.

The station is built with a view to an increase in the steam plant, and the introduction of alternating incandescent machines for commercial, shop and domestic use, which are soon to be installed, besides being of sufficent dimensions to anticipate the growth of the plant. The well-known reputation of the directors and stockholders of the local company as active, progressive, and energetic men of business, affords ample proof that the citizens of St. Albans are not disposed to be at all behind their neighbors in the matter of electric lighting.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., Oct. 31, 1887.

City Councils Sub-Committee on Law, to which was referred the resolution relative to the sale of the Baltimore & Ohio Telegraph lines to the Western Union Company, met last Friday. The resolution, it will be remembered, directs the City Solicitor, in conjunction with the Electrical Bureau and the Joint Law Committee of Councils, to inquire into the sale and merger of the Baltimore & Ohio Telegraph Company to and with the Western Union Company, and upon proof, to rescind the privileges granted to the Baltimore & Ohio by ordinance in this city, and to collect the penalty of the bond of $50,000, held by the city conditional that the Baltimore & Ohio Company should not at any time consolidate with a competing line of telegraph. The resolution also directs the City Solicitor and other officials to take possession of the wires, poles and fixtures of the Baltimore & Ohio Telegraph Company in this city.

At the meeting the city and the telegraph company were represented by counsel, and N. Dubois Miller represented Robert Garrett individually. Superintendent W. B. Gill, of the Western Union, was the only witness examined. He said that he knew of no merger, sale, lease or consolidation of the Baltimore & Ohio interests to the Western Union Company, and moreover, owing to his position in the Western Union Company, such sale, lease, merger or consolidation in this State could not take place without his knowledge. When asked whether there had been any merger or sale of those interests in New York, New Jersey or Maryland, Mr. Gill declined to answer, and a tilt between counsel ensued as to the relevance of the question. Chairman Fow read the ordinance to show that its provisions reached the Baltimore & Ohio in the event of a consolidation with a competing line in any State, and informed Mr. Gill that he intended to go into court and get an order to compel him to answer. Mr. Gill, however, persisted in his refusal to answer questions relating to the affairs of the telegraph company in other States. The witness admitted, under the fire of cross-examination, that since Oct. 1 a former Western Union employé had succeeded the former manager of the Baltimore & Ohio main office in this city.

Mr. Gill was ordered by the chairman to produce at the next meeting his letter-book and all other books, papers and telegrams having any bearing whatever on the subject. The committee adjourned to meet at the call of the chair.

It is highly probable that the transfer of the Baltimore & Ohio's telegraph plant to the Western Union Company, at least so far as the State of Pennsylvania is concerned, is not to be consummated until several legal difficulties have been overcome. Besides referring to the bond of $50,000 given to the city by the B. & O., the newspapers of this city have published a copy of the State law on the subject of consolidation of telegraph lines, which provides that the lines and all property of any competing telegraph lines which merge or consolidate shall be escheated to the State, and shall be then offered for sale at public auction; and have called the Attorney General's attention to the fact that

the law is in full force, with the object in view of having him take steps to have it enforced.

The Baltimore & Ohio had the telegraph line erected through the city a long time before the railroad reached here. Some question has been raised as to whether the line and the poles and fixtures are worth the $50,000 that the company may have to pay. It is asserted that they are worth much more than that amount. Still, with the company out of existence and the Western Union closing its offices, it is held by some that it would be better to let the entire plant go. A good many Baltimore & Ohio operators have already been discharged, and others expect their heads to fall into the basket at any time.

The officials of both companies in this city are inclined to be reticent over the effect of the State law and the effort of Councils to get back the $50,000.

The newspapers of this city are availing themselves of the advantages of special wires in their own offices for the handling of their special matter, and within this month two of the morning journals have been furnished with leased wires to New York, and both of these establishments have also had long-distance telephones placed in their offices in addition. This makes three papers having their own special wires and service, and several first-class telegraphers have been given good-paying positions by reason thereof. It is probable that others will soon fall in line, and in anticipation some of the best operators are watching out for the positions to be created.

The large doorway of Jacob Reed's Sons, Nos. 918, 920 and 922 Chestnut street, has just been adorned with two handsome metal clocks, the interesting feature of which is that they are corrected every hour by a newly-devised electric connection with an accurate chronometer, thus affording correct time of convenient access to the passers to and fro along the busiest part of our leading thoroughfares.

The Baldwin Locomotive Works, which have probably the largest electric light plant in the world, consisting of about 2,700 lights, are doing things in first-class style. They are running all the wires between the various shops in underground conduits, and have been granted permission by City Councils to occupy for that purpose the streets on which their works are located.

Secretary Plummer, of the Main Belting Company, of this city, reports a good business in the cotton belting line and says that the number of customers in the electrical line is increasing very rapidly. The belt manufactured by this company is very highly recommended by those who have used it, and many large establishments have discarded all other belting in order to put in the Main Company's goods.

The Philadelphia Electrical Society has taken possession of its new and permanent quarters, and is in a flourishing condition. Twenty-eight new members were proposed at the last meeting, which brings the total membership up to about 160. Great interest is taken by all, and it is probable that there will soon be over 200 active members on the rolls. E.

PHILADELPHIA, Oct. 31.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Oct. 29, 1887.

If one is to judge from the articles which have appeared in the local newspapers during the past week, it is certain that the Mayor's opinion is decidedly in favor of the electric light for street lighting. One of the most potent arguments that he makes is that the first cost of the plant will be much less than gas-works, and the plant can be put in operation in much less time than by laying gas mains and building retorts. The Mayor estimates that it would require eight arc lamps to the block. We have now only eight gas lamps to the block, each giving from 15 to 20 candle-power, making a total of about 160 candle-power of light now actually in operation on each block in the business portion of the city. The electric light would give about 16,000 candle-power for very little more than the cost of the gas.

The following was passed at the last Council meeting:

Resolved, That the Superintendent of the Fire-Alarm Telegraph prepare and submit to the City Council within two months an estimate of the cost to the city for procuring the necessary plant and supplying electric lighting by the year for the streets and population between Madison, Halsted, and Twelfth streets and Ashland avenue, and also the minimum cost per annum to the consumer in said district for such electric lighting.

I clip the following from a local paper: The City Council seems to have gone to the end of its rope in its alleged efforts to impose a license on the telephone company. Assistant City-Attorney Knight thinks it a good point that some one sprung in the Council Monday night, that the Chicago Telephone Company had no franchise whatever under any city ordinance. It seems that the franchises were granted specifically to the Bell Telephone Company, but not to its successors or assigns. Since the Bell Telephone Company is supposed to have changed hands, this will give the Council somewhat of a chance to fight the new company. On the other hand it is said that the Bell Company owns 51 per cent. of the stock of the Chicago Telephone Company, and it might claim, and doubtless would, that the Company was in fact the Bell Company. No one knows how much the Law Department has done in its efforts to devise a scheme for compelling the telephone company to pay its fair share of municipal taxation, but the department has never yet hinted to the Council that such a scheme can be devised. The measure introduced by the Judiciary Committee is regarded as being the merest child's play.

The Baltimore & Ohio telegraph signs have disappeared, and a number of the offices have been closed. It it conceded that the directors of the Board of Trade will find it to their interest to restore the privileges of the Commercial Quotation Co. which were recently revoked.

Mr. J. W. Adams, of the Adams & Price Machinery Co., has invented and patented an elevated street railway system, for which he claims many good features. Mr. Adams' system is built upon the telpherage plan, with a single track, being supported by a row of pillars upon each side. The plans are for pillars 14 inches in diameter, 30 feet apart. The cars will have six wheels—two driving wheels and four guide wheels. The driving wheels are nigh up in the centre of the car, one in front and one in the rear. The guide wheels lie horizontally on the bottom, and serve merely to steady the car and keep it in place. It is designed to use either cable or electricity. This system has been noticed at some length in the city papers, principally because there has been considerable activity on the part of the men controlling the patent in bringing the scheme to the attention of property owners, more especially on the West side.

The firm of Messrs. Munson & Co., whose belting is so well known to the electric light interests, have found it necessary to remove their manufactory in order to obtain additional room. The capacity will be increased threefold, so that all delay in filling orders promptly will be avoided.

A paper which has been sent me from Salt Lake City states that Secretary Chas. Sydney Smith, of the Rocky Mountain Bell Telephone Company, is at work upon a machine for recording the transmission and receipt of messages automatically by an instrument placed in the circuit of a magneto bell. The idea was first ascribed to Prof. "Von Sydney," who turns out, after investigation, to be the secretary of the Telephone Company. I am not aware that any satisfactory results have been obtained. Mr. Smith modestly denies his connection with the scheme.

The city of Kenosha, Wis., is still in darkness, with no street lights, and with little prospect of any, and no action has been taken on the subject by the city council. The number of burglaries committed this week has served to impress upon the council the necessity of some decisive action.

My St. Louis correspondent has sent me the following:

The Excelsior Electric Company have just completed a plant of 25 arc lights at Mount Vernon, Ill., and one of nine arc lights for J. H. Sass, of Kansas City.

There has been considerable competition and rate cutting in St. Louis recently in the electric light business, one company putting down its price to 50 cents for midnight lights while the others are not inclined to go below 60 and have been getting 75. An understanding for mutual defense in the matter of rates is said to be in existence between the managers of the Brush and Thomson-Houston companies. C. H. M.

THE TELEGRAPH.

An Amicable Understanding.—It is said, and admitted that an amicable understanding exists between the Western Union and Postal companies as to rates. This report has currency in spite of other reports that the Postal is to be made the nucleus of a bigger opposition than ever.

French Cable Enterprise.—A cable dispatch from Paris of Oct. 16 says: The government has granted a concession to the French Cable Company, with interest guaranteed, for a cable connecting Brazil, Central America, the Antilles and New York. Fifteen million francs to construct the cable have been subscribed by a syndicate composed of the Credit Foncier, the Comptoir d'Escompte and the Transatlantic Bank. French cable shares have risen to 145 francs.

Settling with the State.—What promised to be an interesting law suit has just been settled in Indiana by compromise. The State sued the Western Union Telegraph Company for $1,900 for failing to report its property for taxation in 1887. The company's defence was that the tax levied by the State was a trespass on the province of Inter-State commerce. No taxes have been paid by the company since 1880, and the terms of the compromise were that the seven years' arrearages should be paid.

Cable Rates.—It has been Wall street rumor that low cable charges were to be advanced in a day or two, but Mr. Ward, of the Commercial Company, said on Saturday last to the reporters that, while an advance from the present unremunerative rates was pretty sure to be made before long, it could not come before Nov. 1 at the earliest. Notice of a change in the tariff would have to be sent abroad, and to make it general would require time. No change is likely to be made for some days after the 1st.

Chicago Bucket Shops.—A special dispatch of Oct. 26 says: The Commercial Quotation Company, which was recently deprived of its board of trade quotations and denied admission to the floor of the exchange, was restored yesterday to its former privileges. The reinstatement was by vote of the board of trade directory, and is unconditional. The company was ejected from the board by President Wright in the latter part of September, for furnishing quotations to Boston bucket shops, and has been kept off ever since in order to force it to comply with the board's requirements. This it refused to do, and the directors yesterday decided that it could come back on its own terms.

Confirming the Purchase.—The meeting of Western Union stockholders to vote on the confirmation of the purchase of the Baltimore & Ohio lines, and the increase of the stock by $5,000,000, was held on Oct. 28. About $65,000,000 of the capital stock of the company was represented, of which Jay Gould voted by proxy on $25,000,000, and Russell Sage and Sidney Sheppard, of New Haven, who are the second and third largest holders, on $25,000,000 more. No opposition was developed to the great scheme. John J. Terry was the only director present during the meeting. Neither Gould nor Sage deemed it of importance enough to call for their personal attendance. They sent their proxies to Dr. Green.

Another Version.—The Baltimore *News* publishes a statement which Mr. Garrett is reported to have made to an intimate friend last week. Mr. Garrett said that some time before he went to Europe Jay Gould offered him $8,000,000 for the Baltimore & Ohio telegraph, and it was positively refused, Mr. Garrett asking $10,000,000 for the property; that while abroad he organized a syndicate of bankers in Amsterdam, who agreed to buy the telegraph for $10,000,000; that Gould kept track of all his movements, and by influencing two Baltimore & Ohio officials obtained consent to the sale, which was pushed through while Mr. Garrett was on his return voyage, and that Mr. Garrett was accompanied back from Europe by a member of the Amsterdam syndicate, who brought with him a certified check for $3,000,000, which was to have been paid to Mr. Garrett as soon as the papers transferring the telegraph had been drawn.

Southern Lines.—A special dispatch from Richmond, of Oct. 27, says: It has transpired now that the property of the Southern Telegraph Company was bought in the interest of the Western Union Telegraph Company. This was shown to-day in the reports received from Portsmouth, Fredericksburg and Alexandria to the effect that the offices of the New York & Southern Telegraph Company in those cities have been ordered to be closed up, and the wires run into the Western Union offices. It follows, of course, that all the offices of the New York & Southern Company in the South, between Washington and Selma, will be similarly closed and absorbed by the Western Union. These will include Norfolk, Lynchburg, Charlotte, N. C.; Augusta, Atlanta and Savannah, Ga., and Montgomery and Selma, Ala., beside minor offices.

THE TELEPHONE.

Metropolitan.—The Metropolitan Telephone and Telegraph Company has filed at Albany its certificate of an increase of capital stock from $1,000,000 to $3,500,000.

THE ELECTRIC LIGHT.

Green Cove Springs, Fla., is to have water-works and an electric light plant, if all goes well.

York, Pa.—The Edison Company at York has taken a contract to light the streets with the American arc system at $4.86⅔ per light a month.

New York City.—The Union League Club is making arrangements to put in the electric light in its magnificent building, and very happy results are expected.

Yankton, Dak.—A company has been formed at Yankton to establish an Edison central station. The power is to be obtained from an artesian well by means of a turbine wheel.

In a Palace of Pleasure.—The new exhibition building and theatre to be erected next spring on the block occupied by Madison Square Garden is to be lighted throughout by electricity.

West Bay City, Mich.—The officers of the new Howe Electric Company, which will use the Thomson-Houston system, are: S. O. Fisher, president; F. D. Peirson, secretary; and H. H. Warrington, treasurer. The capital stock is $25,000.

Naval Signaling.—Mr. Edison has again brought to notice the subject of distant signaling by means of throwing the rays from the electric light upon the clouds, and by a combination of short and long dashes to communicate from one station to another some twenty miles away. To demonstrate its practicability it is proposed to try it aboard one of the naval vessels fitted with the electric search light.

Pomona, Cal.—The Pomona Gas and Electric Light Company, which was organized recently, has a capital stock of $50,000, all of which has been subscribed. A contract has been made for gas works with Sims & Morris, of San Francisco, to be ready within 30 days, but it is said to be the intention not to put up an electric light plant for the present. Pomona has 3,500 inhabitants and is growing rapidly. Mr. O. F. Griffin is the manager.

London, England.—The Buffalo Cyclorama Company of London, England, has been formed for putting in one of the large American cycloramas into that city. It has been decided to light the entire building with electric lights. A contract has been awarded the American Company for seventy arc lights, which were shipped to London ten days ago, accompanied by an expert of the American Company to put in the installation.

The "Corn Palace," at Sioux City, Ia., built of corn and other cereals, is said to be a very tasteful and attractive structure, and much of its success seems to be due to the use of the electric light. The entire building is lighted by arc lamps, and had it not been for electricity, it would have been impossible to light it up, as the structure is composed of highly combustible material and is not solid. The lamps have been operated from the local United States plant.

San Francisco, Cal.—Samuel H. Taylor, general agent of the Thomson-Houston Electric Company, has opened an office at No. 513 Montgomery street, San Francisco. The Thomson-Houston Company have large plants in the following cities upon the Pacific coast aggregating about 1,200 lights installed during the past three years under Mr. Taylor's supervision: San Francisco, Sacramento, Oakland, Santa Rosa, Woodland, Santa Barbara, San Luis Obispo, Cal., and Reno, Nev. They have just completed the installation of a 30-light isolated plant for the Pacific Lumber Company in Humboldt County. The San Francisco installation is operated by the California Electric Light Company.

The National Senate Chamber.—The Westinghouse Electric Company, of Pittsburgh, have received notice that they have been awarded the contract for lighting the Senate Chamber of the Capitol at Washington. This contract calls for 1,300 electric lights, which will include all candle-power from 9 to 16, 25, 50, 75, 100 and 150. The entire plant will be placed in the building, including the power, machinery and other essentials. Work will begin at once upon the preparations of the material, lamps and wires, and in a few days the machinery will be sent to Washington to be placed in position in time to meet the other work. This is one of the most important contracts that the Westinghouse Company has yet made.

APPLICATIONS OF POWER.

Chattanooga, Tenn.—The Chattanooga Electric Street Railroad Company has been formed to build a road in that city, and will, it is said, begin operations very soon.

Another Electric Boat.—By the command of the French Minister of Marine a series of experiments has been carried out at Havre with a new electric boat, designed for use in the French Navy. The boat under experiment, says the London *Electrician*, was constructed by the Forges et Chantiers de la Méditerranée. The electric motor was from the design of M. Krebs, developed with a velocity of 850 revolutions about 12 horse-power, driving a screw of 0.55 metre in diameter about 280 revolutions per minute. The electric current is furnished to the motor by a bat-

tery of 132 accumulators upon the system of MM. Commelin and Desmazures, presenting, it is said, some decided advantages; but of this it is impossible to speak unless we had a complete knowledge of the invention. The weight of the accumulators was about two tons. They furnish from eighty-seven to eighty-nine ampères, with a difference of potential from 100 to 104 volts. The constructor of the boat guaranteed a velocity of six knots for three hours, with ten horse-power during the experiment. The launch gave 6½ knots during five hours, developing twelve horse-power.

Motors in London.—A special exhibition was made on the North Metropolitan tramways, London, a few weeks ago, of the Elieson motors, propelled by storage batteries, which had run 14,000 miles since Aug. 6, carrying 140,000 passengers at a cost said not to be more than two-thirds that of horse traction. The same day a successful trip was made with the same type of motor and the same power, of the electric launch the "Countess," in the Albert Dock. She is 90 feet long, and her motors are intended to work up to 60 horse-power, at 200 revolutions per minute on a screw propeller 3 ft. 6 in. in diameter, with a pitch of 5 ft. 6 in.

PERSONALS.

Mr. E. J. Richards, of the Thomson-Houston Electric Company, left on Nov. 2 for Sicily on business for the company.

Mr. Jay Gould has at last gone abroad, and it is said that while away he intends to get Western Union listed on the London Stock Exchange.

Mr. Wharton Barker announces that the Chinese telephone and banking concessions were granted to him personally and that the story as to the interest of the Vanderbilts in the negotiations is unfounded.

Mr. G. B. Prescott, Jr., has full charge of the experiments now being made with the Sprague storage car in Boston for the West End road projected by Mr. Whitney. The results of the trials are awaited and watched with the utmost interest.

MISCELLANEOUS NOTES.

Police Signal Systems are now being extensively experimented with at the West Thirtieth street station house, this city.

The Acheson Cal-Electric Converter.—Mr. E. G. Acheson, the electrician of the Standard Underground Cable Company, has been patenting a "cal-electric generator," a machine for the direct conversion of heat into current and power.

An Austrian Electric Organ.—An electric organ is building for the Burg Theatre at Vienna, Austria. The organ will be supplied with a cable upward of 100 yards in length, running all around the stage and the orchestra. It has several operators' stations, at each of which the organ can be worked. The chief station is located in the orchestra, the others in different parts of the stage. The same theatre is already supplied with electric light to avoid the danger of fire.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Electric Fire-Damp Indicator, for indicating or locating fire-damp in mines, etc. Illustrated in THE ELECTRICAL WORLD Oct. 15, 1887. The patents and specifications of this apparatus are owned in this country by Mr. E. Imhauser, 206 Broadway (Room 45), New York. Parties desiring to inspect the Fire-Damp Indicator can see the specifications at Mr. Imhauser's office. A full working apparatus is expected from Europe every day.

Messrs. Chas. A. Schieren & Co.—GENTLEMEN: I have been using two of your link belts in my electric plant at Greenwich, Conn., for the past two months and can bear eye witness to the fact that they possess many important advantages over any and all belts with which I have had experience. They impose less strain upon the dynamo bearings and consequently allow of no heating and the use of less oil. As they are invariably run under little or no tension, the variation due to different atmospheric conditions ceases to be a matter of consequence. These are their chief points of superiority, though not all. I am of the opinion, for instance, that a belt of this character will outlive the purchaser in every case. I recommend them to all electric light manufacturers and users. Yours very truly,

NEW YORK, Oct. 28, 1887. EDW. H. JOHNSON.

STOCK QUOTATIONS.

The following list, compiled by Mr. J. S. Stanton, Broker, 16 and 18 Broad street, gives the current quotations of electrical stocks:

Nov. 1, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	20	35
Am. Tel. & Cable	71	72½
Cen. & So. Am.	75	.....
*Com. Tel	.....	.....
*Gold & Stock	90	95
*Inter. Ocean Tel.	.....	.....
N. Y. Mutual	65	80
Pac. & Atl.	.....	.....
*Postal T. & C.	27	31
South. & Atl.	.....	.....
W. U. Tel.	77	77½
W. U. Scrip.	75	78
W. U. Bonds	118	119
Mut. U. Bonds	87½	88
TELEPHONE.		
Am. Bell	.....	.....
Am. Speaking	110	125
Erie	.....	.....
*Hudson River	50	55

TELEPHONE.	Bid.	Asked.
Mexican	.....	.....
*N. Y. & N. J.	85	90
N. Y. & Pa.	.....	.....
New England	.....	.....
*Southern Bell	.....	150
ELECTRIC LIGHT.		
*Am. Electric	.....	50
*Brush	.....	95
*Brush Ill.	.....	52
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	.....	155
*Edison Ill	.....	.....
*Edison Isolated	.....	.....
*United States	.....	.....
*U. S. Ill.	.....	.....
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

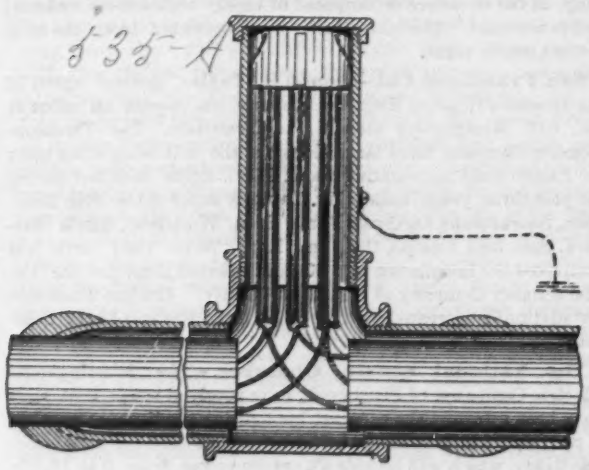
PATENTS DATED OCTOBER 25, 1887.

371,915. Governor for Incandescent Lights on Arc Circuits; C. D. Baker, Chicago, Ill. Application filed Nov. 11, 1886. A single compound solenoid is used in connection with a resistance box and a commutator. For description see THE ELECTRICAL WORLD, Aug. 13, 1887.

(1) 371,936. Electric Railway; (2) 371,937. Rheostat; John Hartman, Jr., of Philadelphia, Pa. Applications filed Nov. 12, 1885. (1) Endless chains pass around sprocket wheels on the axles, and one of the axles is connected by a similar chain to a sprocket wheel on the motor shaft. (2) By means of a lever on the upper surface of the rheostat the same may be brought alternately into contact with the wires through which are passed the positive and negative currents from a dynamo, thus permitting of a change of polarity.

371,940. Electrical Communicating System; A. G. Holcombe, New York, N. Y. Application filed July 20, 1886. Individual lines connect the sub-stations to the central office; a main line connects the central office with all the subs, and a switch-board at the central is provided with two connection plates and push-buttons to which the individual lines are joined; a battery is connected in circuit between the two plates, a switch is provided in the battery circuit, by the manipulation of which the battery connections with the two plates are reversed.

371,958. Electric Current Indicator; W. H. Markland Altoona, Pa. Application filed Sept. 24, 1886. A circular



372,078. UNDERGROUND ELECTRIC CONDUCTOR.

electro-magnet and an S-shaped armature located between and opposite the magnet poles and pivoted to revolve in the plane of the magnet. See illustration.

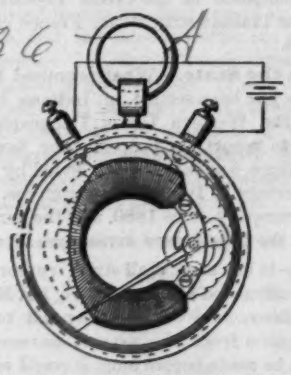
371,965. Hauling Through Conduit Systems; J. F. Munsie, Chicago, Ill. Application filed Dec. 30, 1886. The cable is laid upon a double chain provided with trucks. The chain is then hauled through until the cable is in position, and it is then pulled out, leaving the cable in place.

371,980. Automatic and Autographic Telegraphy; Charles Selden, of Baltimore, Md., Assignor of one half to Wm. T. Barnard, of same place. A transmitting cylinder, a series of contact fingers bearing thereon, a receiving cylinder with a like series of recording pens, a single line circuit between the series of fingers and pens and the circuit connection. See illustration.

372,012. Electrical Resistance Board; I. W. Colburn, Fitchburg, Mass., Assignor to Hanson, Van Winkle & Co., of Newark, N. J. Application filed Feb. 8, 1887. A circular resistance board having a series of plates arranged in a circle, each connected by radial arms with sections of coils also arranged on a circle.

(1) 372,026, (2) 372,027, (3) 372,028, (4) 372,029. Electrical Safe Locks; Charles J. Kintner, Philadelphia, Pa. Applications filed respectively May 11, 16, 16 and July 6, 1887. Circuits are run from the exterior of the safe to electro-magnets within for controlling successively the combinations. A safety circuit is also provided to avoid detection of the combination. See illustration.

372,046. Electrical Primer; G. Stuart, of Elswick Works Newcastle-upon-Tyne, England, Assignor to W. G. Armstrong,

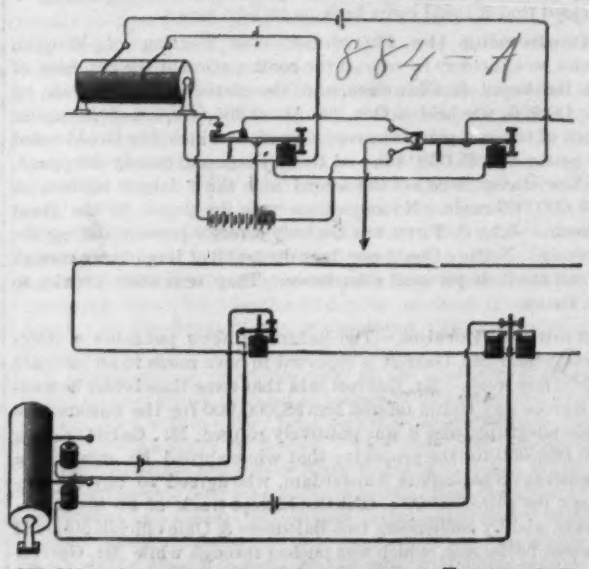


371,958. ELECTRIC CURRENT INDICATOR.

Mitchell & Co. (Limited), of same place. Application filed May 31, 1887. The body of the primer is provided with a main cavity and with a passage of smaller diameter extending rearwardly from the main cavity, an insulated rod passing centrally through the passage and cavity, having upon one end a collar and a packing of compressed asbestus around the collar.

372,078. Underground Electric Conductor; H. Metzger, Pittsburgh, Pa. Application filed June, 4, 1887. Junction boxes are provided, within which the successive sections of conductors may be united; also non-conducting tubes protecting the conductor ends and separating them one from another.

372,155. Telegraph Key and Sounder; G. M. Lane, Asbury Park, N. J. Application filed Feb. 23, 1887. A coiled spring is mounted upon the shaft of the key on each side be-



371,960. AUTOMATIC AND AUTOGRAPHIC TELEGRAPHY.

tween it and the supports, the other ends being held by the supports and the inner ends connected with the key.

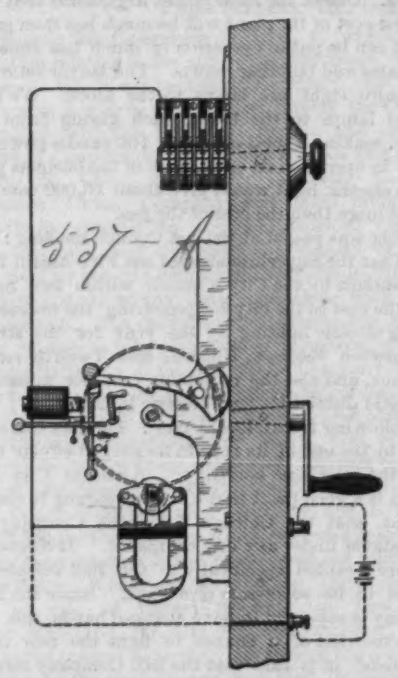
372,168. Coin Operated Induction Coil; W. Oliver, London, England, Assignor to Daniel Judson & Son (Limited), of same place. Application filed Jan. 22, 1887. By the dropping of a coin into a receptacle of the apparatus an electrical current of desired intensity will be administered to a person operating the handles. The strength of the current is registered upon a dial and marked or printed upon a card, which is then ejected.

372,193. Galvanic Battery; J. T. Armstrong, London, England. Application filed Feb. 23, 1886. The fluids used in the battery are periodically changed for others, which destroy the deposit on the electrodes formed by the fluids previously used.

372,201. Regulator for Dynamo-Electric Machines; C. E. L. Brown, of Zurich, Assignor to the Werkzeug und Maschinenfabrik Oerlikon, of Oerlikon, near Zurich, Switzerland. Application filed Sept. 1, 1886. More or less resistance is automatically inserted into the circuit of the field coils. For description see THE ELECTRICAL WORLD, July 30, 1887.

372,208. Electric Valve Controller; S. W. and W. V. Dermitt, Pittsburgh, Pa. Application filed Dec. 11, 1886. A weighted lever operating a valve is held up by a catch which is released by an electro-magnet controlled by a thermostat.

372,231. Regulator for Motors; A. W. Meston, St. Louis, Mo., Assignor of one-half to J. H. Clark, same place.



372,028. ELECTRICAL SAFE LOCK.

Application filed March 1, 1887. A centrifugal governor mounted between a loose pulley on the shaft and the armature, the governor being connected with and controlling the commutator without affecting the electrical connections.

372,245. Autographic Telegraphy; J. E. Watson, Louisville, Ky., Assignor to the International Electric Company, of same place. Application filed April 27, 1886. A continuously rotating stylus carrier having a series of points following each other in the same direction, in combination with suitable tape carriers.

372,247. Call Register for Telephones; A. F. Adams, Little Rock, Ark. Application filed Dec. 22, 1886. A circuit-controlling device is applied to the magneto generator, which must be operated when a generator is used to send a call. When thus operated it actuates a registering device and causes a call to be indicated thereon.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.